N.A.A.S.

Quarterly Review

No. 7

Spring, 1950

LONDON: PUBLISHED FOR THE MINISTRY OF AGRICULTURE AND FISHERIES BY HIS MAJESTY'S STATIONERY OFFICE

ONE SHILLING NET

ABSTRACTORS

AGRICULTURE

Professor T. Dalling, M.A., M.R.C.V.S. ... ... *Animal Health*
Professor R. G. Baskett, M.Sc. ... ... *Animal Nutrition*
W. Longrigg, B.Sc., N.D.A., N.D.D. ... ... *Animal Breeding*
W. Morley Davies, M.A., B.Sc., F.R.I.C. ... ... *Soils*
T. E. Williams, B.Sc. ... ... *Herbage*
D. H. Robinson, B.Sc., Ph.D., N.D.A. ... ... *Crop Husbandry*
C. Culpin, M.A. ... ... *Machinery*

HORTICULTURE

H. B. S. Montgomery, B.A., Ph.D., D.I.C. ... ... *Fruit*
E. Skillman, B.Sc., N.D.H. ... ... *Glasshouse Crops*
Professor R. H. Stoughton, D.Sc., A.R.C.S.... *Flowers and Soilless Culture*
William Plant, B.Sc.(Hort.), Ph.D., N.D.H. *Nutrition of Horticultural Crops*
G. Winter ... ... *Vegetable Crops*

GENETICS

J. L. Fyfe, M.Sc. ... ... *Crops and Plant Breeding*

DAIRYING

A. T. R. Mattick, B.Sc., Ph.D. ... ...*Dairy Bacteriology*
A. S. Foot, M.Sc. ... ... *Dairy Husbandry*

POULTRY

R. Coles, M.Sc.(Econ.), B.A., Ph.D., M.Sc. ... *Poultry Husbandry*

PLANT PATHOLOGY

L. N. Staniland, A.R.C.S. ... ... *Entomology*
H. E. Croxall, B.Sc., Ph.D. ... ... *Mycology*
Kenneth M. Smith, Ph.D., D.Sc., F.R.S. ... ... *Virology*
H. Martin, D.Sc., A.R.C.S., F.R.I.C. ... *Insecticides and Fungicides*

N.A.A.S.

QUARTERLY REVIEW

THE JOURNAL OF THE NATIONAL AGRICULTURAL ADVISORY SERVICE

No. 7 Spring, 1950

CONTENTS

ARTICLES		Page
Infertility in Cattle : 1. Infections	*Professor T. Dalling*	93
Mineral Deficiency Problems in Australia	*J.B.E. Patterson*	96

ABSTRACTS

Animal Breeding	101
Animal Nutrition	102
Dairy Husbandry	104
Dairy Bacteriology	107
Poultry Husbandry	108
Crops and Plant Breeding	110
Crop Husbandry	113
Vegetables	115
Herbage	117
Nutrition of Horticultural Crops	119
Fruit	120
Flowers	123
Glasshouse Crops	124
Mycology	126
Entomology	128
Virology	130
Insecticides and Fungicides	134
Soils	136
Machinery	137

LONDON: HIS MAJESTY'S STATIONERY OFFICE: 1950

Digitized by the Internet Archive
in 2025

https://archive.org/details/adas-quarterly-review_spring-1950_7

ARTICLES

INFERTILITY IN CATTLE

I. INFECTIONS

PROFESSOR T. DALLING

Following the demand for a greater and more regular milk supply, the various factors which might lead to the failure to reach a proposed target have been the subject of much consideration and study. The health of the breeding animals and the control of the many diseases in herds have received due attention, and the part played by veterinarians is readily acknowledged. A subject on which our knowledge is still inadequate is infertility, and much research remains to be carried out before we can claim to be in a position to deal with its various aspects. This does not mean that nothing can be done to restore infertile animals or herds to normal breeding capacity; each case has to be dealt with on its own merits.

Considerable progress was made during the war and has since been continued, in our appreciation and control of infectious conditions of cattle which influence fertility and, broadly speaking, we are able to deal with such conditions in a highly satisfactory manner. We have also come to appreciate more accurately the importance of ensuring that the bull is fertile and is producing potent semen. In the past there has been a tendency to give too little attention to the bull in examining the causes of infertility in a herd; the introduction of artificial insemination has caused us to consider the bull as a possible source of any failure of normal breeding in herds.

For practical purposes the causes of infertility may be divided into the following categories—infections, disturbances of the hormonal regulation, nutrition and genetical causes. This article deals only with the first cause.

It is unusual to find females in the cattle world which are completely sterile—rather do they suffer from a temporary infertility which can be removed often by appropriate treatment. Permanent sterility is usually associated with anatomical defects which cannot be overcome or it may follow a disease condition which has become chronic in character and cannot be alleviated.

Contagious Abortion

One of the commonest infections concerned with infertility is brucellosis (contagious abortion). There is much evidence to show that in herds from which this disease has been eliminated, the incidence of infertility has been markedly reduced. Although *Brucella abortus*, the cause of the infection, may by itself have little influence on the

future fertility of the infected animal, its presence in the genital tract allows the multiplication and penetration of other, normally harmless, micro-organisms to occur, resulting in an inflammation of parts or the whole of the genital tract. This inflammatory condition may be mild in character, but until it subsides there is little chance of conception taking place. The condition may be confined to the uterus, when a metritis is the result, or it may extend into the fallopian tubes, causing a salpingitis or it may even cause infection of the ovaries. In the two latter conditions chronic changes may occur which render the animal permanently sterile. Retention of the placenta (afterbirth) is a common sequel to brucella infection, the decaying tissues forming a very suitable medium for the multiplication of some of the common types of invading micro-organisms. There is now no real excuse for the presence of brucellosis in a herd. It has been shown, not only in this country but in many parts of the world, that the infection can be almost entirely prevented by the vaccination of cattle, using the now world-famous Strain 19 vaccine. It has, of course, been stated that vaccination itself may give rise to temporary infertility in cows and heifers, following the use of the vaccine even in calfhood. Such claims have been fully investigated in many countries, including our own, and it can be confidently said that there is no evidence whatever to support the alleged observations. Some of the best evidence comes from New Zealand, where lengthy and well-controlled trials were carried out. In Great Britain we have also made numerous observations on the subject and we have failed completely to find any direct association between the use of Strain 19 vaccine and subsequent infertility in treated animals. In considering brucella infection as a cause of infertility, it must not be forgotten that bulls may become infected. The micro-organisms become localized in the genital tract and ultimately render the infected bull completely sterile. Before the infection becomes completely established in the bull, however, the chances of the transmission of brucella infection at service are considerable and, even in the absence of established infection in the bull, he may act as a mechanical carrier of brucella from infected to healthy females.

One of the important micro-organisms associated with infection of the uterus is the *Corynebacterium pyogenes*. It is found in various sites in the body of cattle and would appear, on occasion, to become localized in the uterus. It may be that it really is an invader, secondary to other micro-organismal invasion. Nevertheless, it is now recognized as a cause of metritis, sometimes of an extensive character. Cattle appear to be highly susceptible to these micro-organisms. Although their presence in the genital tract can now be dealt with satisfactorily, they give rise to a considerable amount of trouble from the fertility point of view. It is of interest to note that, although the semen of some bulls may contain *Corynebacterium pyogenes*, there is little evidence to show that infection of females takes place at service ; it would appear that the healthy genital tract can deal with such micro-organisms and prevent their settling down and multiplying.

Trichomoniasis

Trichomoniasis is an infectious condition of both males and females, and is a cause of infertility. The infective agent is a small protozoan parasite, *Trichomonas foetus*, which is found in the uterus of the female and in parts of the genital organs of the bull. There is no doubt that the infection is kept alive in the bull and that infected bulls are the sources of new and continuing infections throughout the country. The communal bull is the important disseminator of the disease. In infected females, abortion in the early stages of pregnancy is common and, repeated abortions are often found in the course of an outbreak. Sometimes the aborted foetuses are so small that they are not seen, with the result that it may be assumed that conception has not taken place. Infected females tend to spontaneous recovery if they are not bred for some months ; so far as is known today, infected bulls do not recover, but remain carriers of the parasite all their lives. Although it is claimed that infected bulls can be successfully treated, more research work is necessary before it can be generally accepted that cures can be effected. The advice still is to cease breeding from an infected bull—he is better destroyed. Methods of diagnosis have been worked out and it is now possible more easily to establish the presence of infection in a herd than formerly. Reliance is, however, still placed to a great extent on the recognition of the infective agent in the discharges from females, in the aborted foetus and in the sheath washings of the bull. The surest method of controlling trichomoniasis rapidly and of restoring an infected herd to breeding capacity at an early date is to have all the females subjected to suitable irrigation before service and to use artificial insemination with semen from a healthy bull. The greatest possible precautions are taken to ensure that bulls at artificial insemination centres are free from, and maintained free from, trichomonad and other infections.

Vibrio Foetus Infection

An infection leading to infertility to which attention has been drawn in more recent times is that caused by the micro-organism. *Vibrio foetus*. Its existence in this and other countries has been known for many years and its association with abortion and subsequent infertility was established ; it would appear, however, that the infection is becoming more widespread in several countries, including our own. So far as can be shown at present, it appears that the infection follows much the same course as does trichomoniasis and that the infecting micro-organism is transmitted by the bull. There seems to be one difference, however, in that in *Vibrio foetus* infection, infected cows apparently develop an immunity after a period so that they resist further infection and after a period of infertility, lasting usually about a year, they begin to breed normally, although mated to the originally infected bull which may still be transmitting the micro-organism. It seems also that infected females may carry their calves for longer periods than in the case of trichomoniasis. This

disease is now the subject of intensive study in this and other countries, and methods of diagnosis and control are being worked out.

There is some evidence that cows and possibly bulls suffer from virus infections of the genital organs which give rise to infertility. There exists, for example, an inflammatory condition of the cervix of the uterus and of the vagina, from which sites it is possible to recover an agent which has been shown to possess some of the characters of an infective virus. Research work on this condition is steadily proceeding, but it is too early yet to draw any definite conclusions from the results available to date.

Tuberculosis of the uterus and other parts of the genital tract must not be forgotten in considering the causes of infertility associated with infective agents. It may give rise to infertility, or even actual sterility, in addition to the spread of tuberculous infection through discharges and the birth of infected calves. The control of this infection is simple—the eradication of tuberculosis from the herd.

MINERAL DEFICIENCY PROBLEMS IN AUSTRALIA

J. B. E. PATTERSON

During the past fifteen or twenty years the immense importance of " micro-nutrient " elements for plants and animal life has been demonstrated all over the world. Australian research workers have played a leading part in this work and have been foremost in unravelling the connection between cobalt and copper and animal well-being, as well as showing how immense tracts of land need only minute quantities of zinc, copper and molybdenum for the production of herbage suitable for stock grazing, or of stone or citrous fruits. Some of the problems, such as Whiptail in Brassicae and simple pining in sheep, are comparable with similar ones in this country, while there are many others which bear some relationship to diseases of stock outside Australia, yet differ in detail, such as Enzootic Ataxia in sheep which has many similarities to " swayback " in England.

That Australians have often shown the way to their colleagues in the elucidation of the causes and treatment of these diseases is evidenced by the work of Underwood and Filmer on cobalt deficiency in sheep and cattle, of Bennetts on copper and its relationship to Enzootic Ataxia in sheep and " falling disease " in cattle, of Marston and Lines on cobalt and copper deficiency in stock, and of Bull on toxaemic jaundice in sheep. Similar leadership has been shown on the plants side by Anderson on the necessity for molybdenum in subterranean clover, by Piper on molybdenum, copper and manganese for oats, and by Dunne on copper in apples and molybdenum in Brassicae. The

names of Teakel, Prescott, Wilson, Leeper and Riceman are also well known to specialists in plant nutrition.

During the late summer and early autumn a number of specialists in plant and animal nutrition from this country were able to see some of the work now being done in the field and at research institutions in Australia, and to discuss common problems with other workers from most of the countries in the British Commonwealth. The occasion was that of the first British Commonwealth Specialist Agricultural Conference on Plant and Animal Nutrition in relation to Soil and Climatic Factors, which was held in Adelaide in August 1949, when over 70 papers on many aspects of these subjects were discussed. The Conference itself was followed by a tour, lasting more than two months, over much of the southern half of the continent in which research institutions and State Departments of Agriculture were visited and many farms, properties and experimental schemes seen.

Obviously even an intensive tour of this kind can cover only a small portion of the vast continent in detail, but by specialization members of delegations were able to see a very good cross-section of the aspects of agriculture in which each was most interested. Any account of deficiency problems to be found in three million square miles of land is bound to have some omissions, but it is believed that there are no serious deficiency conditions which will not be touched upon in this brief account.

Diagnosis of Deficiencies

Geologically, Australia is one of the oldest parts of the world, and climatic conditions producing extreme and prolonged leaching, combined with widespread distribution of parent rock materials naturally poor in basic minerals, have resulted in large areas being covered with soils deficient in zinc, copper, cobalt, molybdenum, boron, and manganese. Until fairly recently this condition severely limited the improvement of stock grazing or the extension of arable cropping and commercial fruit growing, but the recognition of specific deficiencies has been followed by soil treatment, and the prospects of greatly increased agricultural production in some parts of Western Australia, South Australia, New South Wales and Victoria are very good.

Soil surveys are used on a large scale to help in this work. These surveys are organized under the Division of Soils of the C.S.I.R.O. which has its headquarters at the Waite Institute, Adelaide. Up to now the method has been correlation of field experiments and observations with soil groups and series, but work on geochemical relationships is now in hand. Copper is deficient in podsolized sands in South Australia and in the derivatives of lateritic formations in Western Australia and South Australia, as well as in some brown solonized soils. Podsolic and Brown soils in parts of New South Wales, South Australia and Tasmania do not provide enough molybdenum for clover and brassicae, while calcareous sands in South Australia, and podsolic and lateritic soil in Western Australia are deficient in cobalt.

The general problem of diagnosing of deficiency of any particular element is complicated by the occurrence of simultaneous deficiencies of several elements, which raises problems of special difficulty on mixed pastures where the requirements of all species are not the same for each element, and when any species may need a particular micro-nutrient at one stage of its growth and another one at a subsequent stage. Thus Riceman found that subterranean clover on the leached siliceous sands of the Ninety-mile Plain in S.E. South Australia needs zinc for vegetative growth and copper for seed production, and that neither element can replace the other, whereas lucerne needs copper for vegetative growth and zinc does not appear to be essential. Diagnosis of trouble is made difficult by the absence of visual symptoms of even acute deficiency of certain elements in some plants. Chemical analysis and tissue tests have sometimes, but not always, been found useful, and the most reliable method of detecting concealed deficiencies is the laying down of controlled field plots, on lines similar to those developed at Long Ashton by Wallace and his colleagues. Accurate diagnosis in advance of deficiencies likely to be met in areas considered for future development is a problem which can be solved only by the plot technique, correlated with soil surveys, with the hope of improvements in laboratory analyses of soils and plant material enabling a further correlation to be made. One other source of information which is occasionally available is that given obliquely by animals grazing on deficient land. Sheep on pasture deficient in copper grow fleeces without any crimp, which is restored when copper is given again in the diet; and "steely" wool indicates a natural lack of copper not indicated by visual symptoms in plants. Similarly, in Australia, analysis of the cobalt content of the liver of sheep will give conclusive evidence of cobalt deficiency in the diet.

Effect of Deficiencies on Plant Nutrients

The interrelationship of the effects of plant nutrients is of particular interest in soils of the types found over large tracts in Australia where relatively low levels of fertility prevail and the phosphorus and nitrogen status is so low that only the native flora, adapted to such conditions, can flourish and normal crop production is impossible without fertilizer treatment. Examples of this are the effect of zinc on the uptake of phosphorus by plants and of phosphorus on the metabolism of zinc, and the antagonistic effect of zinc on the metabolism of iron. These are being studied in Australia, where several research workers are interested in the problems, including that of the relationship between the zinc content of leaves and the intensity of illumination. In some of the plantations of the state forest of South Australia at Mount Burr and in parts of Western Australia, young trees of *Pinus radiata* may suffer from "rosette" disease which can be cured by spraying the young trees at the age of about 3 years with a $2\frac{1}{4}$ per cent solution of zinc salts. If no treatment is given and the trees survive to give some annual growth, the gradually developing partial shading given by the canopy provides a cure, although the trees naturally do not recover their rate of growth

so rapidly as others which have not received a check. This effect of shading indicates a relationship between light intensity and zinc assimilation. Severe symptoms of deficiency in fruit trees are sometimes seen on the side fully exposed to the sun, while on the shady side they are less severe or absent. Zinc metabolism is often linked with climatic conditions generally, and this aspect is being investigated in flax and clover in pot experiments at the Waite Institute.

Zinc deficiency is prevalent on citrous fruits over wide areas. The symptoms are similar to those found in California—chlorotic mottling of the leaves and the formation of bunches of very small leaves at the shoot tips. Treatment by zinc sprays is simple and effective and is widely used.

The dependence of much land on zinc for healthy growth of plants was shown during the war when the island of Nauru was occupied by the Japanese and could no longer be used to supply rock phosphate for the manufacture of the superphosphate used in Australia until then. North African phosphate was imported for the same purpose but gave poorer results, which were traced to its lower contents of zinc than the Nauru rock.

Copper supports agricultural production widely in Australia. Its essentiality for seed production in clover in the Ninety-mile Plain is mentioned above. In mixed pastures of subterranean clover, lucerne and *Phalaris tuberosa*, it was found that copper had no effects on vegetation development of clover and no effect on seed production if zinc had not been given first, whereas for lucerne, copper only was needed and had no effect on *Phalaris*.

On the calcareous sands in S.E. South Australia the lack of copper affects both crops and stock. Cereal crops, especially oats, respond dramatically to a dressing of 14-56 lb. copper sulphate per acre, while Wimmera ryegrass and similar pasture plants can be introduced where they would not grow before. The effect of soil *p*H on the uptake of copper has been studied by Piper, using several soil types with three pasture plant species. He has found that this is small but that in certain species uptake is favoured by low soil *p*H. More important appears to be what may be a micro-biological effect. Dressings of copper sulphate given several months before sowing of the crop are very much more effective than when given at seeding—in fact, 14 lb. given early are equal to 56 lb. at seeding. So far, no explanation of this has been put forward.

Effect of Deficiencies on Livestock

To those interested in the mineral nutrition of animals, the names Gin-Gin and Robe are familiar, for at the former Bennetts carried out his classical work on Enzootic Ataxia in sheep similar generally to Swayback, except that in Australia the copper content of herbage is much lower than that in England, where there appears to be some factor preventing the proper assimilation of the copper or its transference to the foetus. At the latter, Marston and his colleagues have

shown the need of copper and cobalt for the prevention and cure of Coast Disease in sheep. Bennetts has also shown that the " falling disease " of cattle found in the Denmark District in S.W. Western Australia is associated with very low copper figures in pastures. This disorder, during spring flushes of grass, causes the animals to lose condition, become sterile temporarily and to fall down suddenly when driven or excited.

A condition in sheep known as " toxaemic jaundice " in which an excess of copper is absorbed by sheep is being investigated by Bull and his colleagues. No such disease is known outside Australia. It occurs on soils of normal or high copper content and is associated with liver damage caused by poisoning with the summer annual plants *Heliotropium Europaeum.* Chronic poisoning of sheep by excess of copper is known in Victoria and New South Wales and causes severe losses in flocks. Recent work, favoured by unusual climatic conditions in 1946, links it with subterranean clover and suggests that the ratio of copper/molybdenum is important in the availability of copper in the diet of sheep. Piper has studied the relationship of this ratio to soil conditions for several soils and pasture plants and finds that it widens considerably in the spring.

Molybdenum is essential for subterranean clover and is distributed in the form of sodium molybdate over large areas in Western Australia, South Australia, Tasmania and New South Wales. For oats, also, it is necessary in the same area. In New South Wales, South Australia, Western Australia and Queensland the disease of cauliflower and other Brassicae known as "Whiptail" is fairly widely spread on acid, sandy soils and much of our knowledge of this disorder is due to Australian workers in Perth, Adelaide and Sydney.

Of the other common mineral nutritional troubles in plants, those caused by both deficiency and excess of manganese and boron occur, while the poisoning of stock by excess of both selenium and fluorine is known in Queensland.

In a brief account of this kind, only the barest outline of the wide range of problems and the progress towards their solution can be given. Enough perhaps has been said to show how numerous they are, what great progress has been made in solving them, and how we may look to Australia for further advances on the road to bringing great tracts of land into agricultural use.

ABSTRACTS

ANIMAL BREEDING

The Inheritance of a Tail Abnormality Associated with Urogenital Disorders in Pigs. Donald, H. P., *J. Agric. Sci.*, 1949, **39**, 164.

A condition which is generally described as " kinky tail " was first found in an inbred strain of Large White pigs which were descended from the stock of Dr. J. Hammond at Cambridge. The majority of cases occurred in the stock moved from Cambridge to the Institute of Animal Genetics, Edinburgh, and it was there that the independent cases were discovered amongst other pigs of both the Large White and Wessex Saddleback breeds. This condition has also been found in one English and two Swedish herds of Large White pigs without any systematic search having been made.

The deformed tail is usually shorter and contains fewer caudal vertebrae, but there may be considerable variation ; in extreme cases the tail is reduced to a twisted stump. Kinkiness is usually associated with disorders of the kidneys, ureters and genetalia which may result in sterility. Most cases of kinky tails were traced to a single brother-sister mating amongst the inbred pigs, but sporadic outbreaks were also found amongst outcross pigs. Epidemics may occur amongst litters from apparently normal inbred parents, some of which contain no normal pigs.

Cases have been found where boars have transmitted kinkiness to outcross and crossbred litters. Genetically it does not follow any clear-cut Mendelian pattern. There may be times when a gene has sufficient effect, when present in a single dose, to upset the equilibrium, while in other cases it may need to be present as a double dose.

As, however, all three cases of kinky tails found outside the Institute has some degree of inbreeding, it would seem that some genes act as recessives. The epidemic amongst inbred pigs from apparently normal parents, may have been the result of the combination of predisposing genes in both litters and sows. Genes transmitted by some inbred boars to outcross pigs lost some potency partly because of heterosis, and partly because of better uterine environment.

It would appear that kinky tails are but a minor symptom of any early embryonic disorder which frequently involves the urogenital as well as the skeletal system.

Summary of the Progress of the Dairy Cattle Breeding Experiments at the Agricultural Research Centre, Beltsville. U.S. Dept. of Agriculture. *BDIM-Inf*-8.

Dairy cattle-breeding investigations were begun at Beltsville in 1912. The breeding project with Holstein and Jersey cattle was started in 1919, with the object of developing strains with high milk and butterfat inheritance.

Recorded yields are made under standardized conditions of feeding and management, during which time all cattle are kept indoors where

they are fed strictly according to their size and production. They are milked three times a day, and are all tested as heifers and again as mature cows.

Since the start of the experiments there has been no selection whatever, all females having been tested regardless of type or ability.

In the Holstein herd it was planned to produce a strain of high-producing cattle by the continuous use of unrelated Holstein sires. This has progressed to the seventh sire. The daughters of these bulls have yielded consistently, varying from 16,504 lb. milk, 659 lb. butter fat (3.95 per cent) for the nine daughters of the lowest bull, to 22,987 lb. milk 881 lb. butter fat (3.85 per cent) for the 46 daughters of the best bull. These yields were corrected and presented as for mature cows. The 34 foundation females in the Holstein Herd averaged 678 lb. of butter fat, whilst the 55 cows in the herd at present averaged 845 lb. of butter fat.

A project is now planned where the sons of the previously mentioned proven sires are to be used to produce line-bred groups of daughters for comparison with the outbred groups.

In the Jersey herd, three groups were established by the continuous use of proven sires of three differing lines of breeding. There has been considerable improvement in production in each of the lines. The 43 foundation Jersey cows averaged 622 lb. of butter fat and the 27 Jersey females which have completed a lactation and are now in the herd, have averaged 800 lb. of butter fat.

W.L.

ANIMAL NUTRITION

Efficiency of Conversion

A great deal of research work has been devoted to the establishment of feeding standards for various classes of farm animals, and scientific rationing is today based on these standards. There is, however, another aspect of animal production which has significance not only to the farmer, who is mainly concerned with economic production, but also to the nation as a whole. This aspect is concerned with the relative efficiency with which animals convert feedingstuffs into food for the human. A very complete examination of available information on this subject was made in a Technical Communication by Leitch and Godden published by the Commonwealth Bureau of Animal Nutrition in 1941. The main findings of this work formed the basis of a paper read by Mr. Godden to the Agricultural Education Association and published in *Agricultural Progress* (1948, **23,** 105-14). The author gives a brief summary of the factors which are taken into consideration in the formulation of feeding standards and discusses the different ways in which one can arrive at a basis for comparing the efficiency of animals as converters of feedingstuffs. It is possible to distinguish between the efficiency of conversion of the " production " ration and the " total " ration ; the latter takes into consideration that part of the ration which is needed for maintenance. While the former method is of particular interest in

relation to milk production and egg production (where the products lend themselves to accurate measurement and where it is possible to distinguish more or less accurately between maintenance requirements and production requirements), the latter method—total efficiency—is of more general practical interest. The comparison of conversion efficiencies is based on calculations of gross digestible energies of the feedingstuffs making up the various rations for different classes of livestock and using energy values of 4.1, 4.1 and 9.3 calories per gramme of protein, carbohydrate and fat respectively in the produce. The author states that, where possible, the results were related to standards recommended by the Ministry of Agriculture and supplemented, where necessary, by reference to other sources.

The figures for the conversion efficiency of an animal will depend upon the method of assessment, e.g., it may be made (1) on the daily milk production for one day of the animal's life ; (2) on a yearly basis of milk yield ; or (3) on the whole life period. This last probably gives the truest picture. Other factors are summer feeding conditions with all grass and no supplements, winter feeding indoors with hay and concentrates, and differences which arise due to autumn and spring calving. Similarly, in the case of egg production different conversion figures will be obtained when calculations are made on the basis of (i) one egg daily ; (ii) two hundred eggs per year ; or (iii) a lower production of only 120 eggs per year. Equally, the efficiency of conversion varies in meat production according to whether the animal is slaughtered at an early stage (baby beef or pork production) or later (bacon and fat bullock production). Restricted and unrestricted feeding also affect the figures.

The author reproduces tables showing the results of calculations which have been made of the efficiency of conversion by various classes of animals. These calculations relate to different levels of production—daily production, yearly production and whole life production. In the case of the milking cow, cognisance is taken not only of the milk produced but also of the calves and beef from the cow at the end of her productive life. These figures form a basis for comparison between different classes of animals and different systems of production. It is pointed out that the comparisons are only valid when comparable periods are chosen ; for example, the efficiency of fattening of the mature bullock or pig can be best compared with that of the cow in full lactation, and the efficiency of the bullock from birth to slaughter (baby beef) with a complete year in the life of a cow. Bearing these facts in mind, it is seen that a cow giving 6 gallons a day shows an efficiency as denoted by the percentage conversion figures for dry matter, energy, protein and fat of 24.0, 40.9, 47.0 and 11.4 respectively. These surpass the efficiencies of all other animals, with the exception of fat production in the case of a bacon pig on restricted feeding. Even the cow giving 4 gallons a day displays a remarkable ability as a converter. This is of particular importance when it is borne in mind that the cow makes use of energy and protein which is associated with coarse fodders which are unsuitable ingredients in the diet of such animals as pigs and poultry.

Other outstanding performances in conversion are made by the hen in converting proteins from feedingstuffs into egg protein for human consumption, and the fattening pig displays a very efficient conversion of energy, coupled with a marked ability in fat production.

The author draws attention to the fact that pigs and poultry can deal only with the more concentrated types of feedingstuffs and are to some extent competitors with the human race for food. This is not the case to any marked degree with ruminants. Nevertheless, animal products such as eggs and bacon have a special value from the point of view of palatability, and animal products, in addition to their energy and protein values, in many cases act as good sources of minerals and vitamins.

The paper concludes with an assessment, based on statistics for pre-war stock population and total feedingstuffs consumed, of an overall efficiency conversion of 8.7 per cent for energy, 11.1 per cent for protein and 3.3 per cent for fat.

R.G.B.

DAIRY HUSBANDRY

Hay and the Dairy Farmer

More than seven million tons of hay were harvested in England and Wales in 1949 (*Monthly Digest of Statistics*, Oct., 1949). Thus, although an increasing quantity of silage is made, hay still forms the basis of the winter ration for the majority of our dairy stock, and its quality is reflected in the quantity and possibly the quality of the milk which it produces.

Much of the hay made in Britain is of average quality. Twenty-two samples of meadow hay examined by Watson and Ferguson (*Agriculture*, 1937, **44**, 247-60) had an average of 8.92 per cent crude protein in the dry matter and only two samples were classed as very good when based upon starch equivalent values. The average crude protein content of 80 samples of hay grown in 1935 and 1936 was found by Davies (*J. Soc. Chem. Ind.*, 1938, **57**, 417-8) to be 9.6 per cent of the dry matter. Samples from the wet harvest year (1936) were higher in moisture and fibre but lower in protein, soluble carbohydrates and ash compared with those from the drier season (1935). Samples from 75 ricks in the south-west of England were investigated by Ling and Smith (*Bath and West and S. Counties J.*, 1939-40). The crude protein in the dry matter averaged 10.86 per cent and the samples may be regarded as of medium quality only. Lower values have recently been recorded by Ryan (*Jour. Eire Dept. Agric.*, 1947, **44**, 56) who found an average of 7.59 per cent crude protein in 36 samples of Irish hay and by Smith and Comrie (*Scot. Agric.*, 1948, **28**, 67-70) whose mean was 6.08 per cent crude protein in dry matter of 62 samples of Lothians seed hay. These figures should be considered in the light of the examples given by Woodman (*Rations for Livestock, M.A.F. Bull.*, **48**, 1949) who classified meadow hays with contents of 8.75, 10.12 and 11.31 per cent crude protein in the dry matter as " poor," " medium " and " good " respectively.

Methods available to the farmer to improve the quality of his hay include (i) the correct application of fertilizers (ii) earlier cutting, and (iii) improved handling of the crop to prevent loss of nutrients.

Basic slag applied to very poor grassland increased the phosphoric acid and lime content of hay three or four years after application (Fagan, T. W., *Welsh J. Agric.*,1928, **4**, 92). As a result of twelve experiments conducted in 1938-40, Lewis (*Emp. J. Expt. Agric.*, 1941, **9**, 43-9) showed that 1 cwt. per acre of soluble nitrogenous fertilizer applied to meadow land seven to twenty days before mowing, increased the protein content of the hay by 1 per cent without affecting yield. Two cwt. of fertilizer gave an increase of 1.75 per cent. 20 lb. of hay (the maintenance ration of a 10-cwt. cow), dressed at the rate of 2 cwt., would thus supply sufficient *extra* protein equivalent for 0.44 gallons of milk. Confirmatory results were obtained by Ferguson (*J. Agric. Sci.*, 1948, **38**, 33) on both good leys and poor pasture. The digestibility of the protein was significantly higher in the top-dressed hays.

By cutting the hay crop three weeks earlier, Watson (*The Science and Practice of Conservation:* Grass and Forage Crops, 1939) increased the percentage of crude protein in the dry matter from 7.26 to 12.77, the starch equivalent from 38.3 to 47.9, and the protein equivalent from 3.03 to 6.78. The total yield of dry matter per acre was reduced but the protein equivalent was increased. Fagan (1928) records the crude protein of mixed seeds hay dry matter falling from 10.84 per cent to 6.74 per cent by delaying cutting 17 days. Earlier cutting and adequate fertilizing demand improved drying methods for the maximum retention of nutrients in the crop. Holmes (*Agric. Progress*, 1947, **22**, 71) considers that Proctor tripods are suitable in this country as the hay can be put up in field ricks of 5-7 cwt. with a moisture content of 40-50 per cent, whilst the colour and palatability of the hay is preserved. This method was shown by Ratcliffe (*Agriculture*, 1947, **54**, 63-7) in the south of England to increase production costs from 24s. 6d. per ton for pick-up baling to 49s. 9d. when using tripods, but the former method might not be suitable in the wetter north. The conclusion of Mayne and Wadsworth (*Agriculture*, 1946, **53**, 66-70) who studied haymaking in Yorkshire, is that, in a poor season, baling is likely to be slower, more costly and more risky than orthodox haymaking. Where hay must be stacked although not quite fit, the addition of 25 lb. of salt per ton of hay has been found effective in reducing fermentation and mould growth (Philips, Davies and Ashton, *Agriculture*, 1945, **52**, 98-101).

With the abundance of straw and more grass silage now available for feeding, it might conceivably be advantageous to make a smaller quantity of higher quality hay involving more hand work rather than larger amounts of low or medium quality hay.

Herd Fertility

Before the war, a number of surveys were made in Britain to ascertain the extent of " wastage " of dairy cows. This term was used to cover all disposals of cattle from herds, whatever their destination. A striking

feature of all these investigations was the high proportion of cows sold because of sterility. Most of these surveys included some herds where milk records were not high and it seems probable that some of the so-called "sterile" cows were animals which had returned once or twice to service and had then been sold for slaughter since they were worth almost as much for meat as for milk production. They were not all sterile in the physiological or pathological sense. This point is very clearly brought out in a study made by Foot and Ridler (*Emp. J. Exp. Agric.*, 1949, **17**, 229) in which the detailed breeding records of a large self-contained herd over a period of ten years were examined. Each year only about 5 per cent of the herd appeared to be absolutely sterile, although conception difficulties may have been a partial cause of disposal in the case of some animals. The data showed that of 151 animals unsuccessfully served twice, no less than 110 were eventually got in calf and in this particular herd at least 3 repeat services normally appeared to be worth while. The conception rate was shown to be lower in the maiden heifer and first-calf cow age groups but it was pointed out that this may have been due to the culling of inherently infertile animals from the older age groups.

In New Zealand large-scale surveys of the fertility of dairy cows have been carried out for a number of years. Recently a study was made of the comparative fertility of cows when vaccinated and when not vaccinated with strain 19 vaccine, (*N.Z. Dairy Board 24th Ann. Rpt.*, 1948). 91.7 per cent of non-vaccinated heifers were got in-calf by the end of the mating season, while 94.4 per cent of vaccinated heifers (in the same herds) conceived. A similar small margin in favour of vaccinated animals was found in older animals and the data appear to dispose of the theory, sometimes advanced, that vaccination with strain 19 increases sterility.

Since conception rates often fluctuate without any evidence of change in the incidence of disease in the reproductive organs, it is reasonable to suppose that certain nutritional or physiological factors influence the fertility of cattle. This aspect is discussed by Edwards (*Brit. J. Nutrit.*, 1949, **3**, 87) in relation to conception rates for cattle inseminated artificially. In 1947 and again in 1948 there appeared to be a slight drop in conception rates in the period April-June as opposed to the remainder of the year. Although the difference was small, it does at least cast doubt on a rather common theory that the grazing season helps to rectify breeding troubles. Edwards also points to specific artificial insemination centres where, for certain periods, conception rates dropped drastically and then recovered without any obvious cause, but where the impression was left that certain general causes were influencing fertility on a widespread scale.

One cause of failure to get animals in calf, is due to inability to detect oestrus. For this detection, a small instrument, called an oestroscope, recently on view at the London Dairy Show aroused considerable interest. The instrument was described in 1945 (*Agriculture*, 1945, **51**, 456-7) and many tests since have proved its usefulness in detecting silent heat.

A.S.F.

DAIRY BACTERIOLOGY

Microbiological Processes in Milk and Dairy Products

The 12th International Dairy Congress was held in Stockholm in August, 1949.

Many papers on subjects of interest to the dairy bacteriologist were read in Section II, 4, and are reproduced in Vol. II of the Congress reports. All these papers were summarized as a General Report which appears in Volume 6, p. 93, of the Congress Reports. This report embodies useful summaries of the work to date on bacteriophage, on cheese and butter making, on the inhibitory streptococci and on the bacteriology and biochemistry of butter. The influence of various bacterial types and fermentations on cheese making and ripening is also considered with further sections on milk and milk products.

Bacteriophage in Typing Lactic Streptococci

A. A. Nichols and M. Hoyle (*J. Dairy Res.*, 1949, **16,** 167-208) give a valuable detailed account of their work with the bacteriophages attacking starter organisms over the last few years.

Methods of selection, storage and maintenance of suitable starters are discussed together with their sources and the technique for securing phages of high titre.

The authors report good progress in identifying the organisms by creating " phage patterns " on lines similar to those used for typing staphylococci. The phages used in typing were classified by means of antiphage sera and it was found that the majority fell into 3 groups. The phenomenon of " phage-carrying " was investigated and confirmed, and the phenomenon of lysogenesis explored.

Whilst it was not possible to prove it unequivocally, one strain was believed to be lysogenic. It has since been shown by Reiter (*Nature*, 1949, **164,** 667-8) that lysogenic strains of lactic streptococci do in fact exist and D. I. Shew (*Nature*, 1949, **164,** 492) has shown the value of calcium ions for the development of phages for the lactic streptococci.

Nichols and Hoyle also discuss the meaning of phage typing, phage adaptation and the phage-carrying phenomenon in the selection of starters and the methods of applying present knowledge to the control of slowness in cheese manufacture. Reiter's demonstration of lysogenic strains, which cannot be freed from phage, makes it necessary, in addition to the precautions now known, to ensure that none of the strains used in a starter rotation is lysogenic.

Differentiation of Living and Dead Cells

An article by R. Ehrlich (*Die Milchwissenschaft*, 1949, **4,** 241-4 and 327-32) gives an account of work on the differentiation by staining of living and dead organisms. If the method finally described should fulfil its promise, it would be of interest and value to many bacteriologists. The technique is as follows :

(a) Flame the slide well to remove grease.

(b) Put on a drop of sterile water, mix in a drop of the material to be examined, mix and spread thinly with a loop.

(c) Dry gently over the flame or, better, in air. Fix cautiously in the flame.
(d) Stain for 20-25 sec. with Loeffler's Methylene blue solution and rinse in running water.
(e) Without drying stain with Fuchsin* solution + KOH for 50-60 sec.
Wash and dry as usual.
Under the microscope living organisms appear blue and dead organisms red.
*10-15 per cent Fuchsin (Stand 333545 Behringwerke L. G. Farbenindustrie) in 96 per cent alcohol. Of this take 30 ml. and add 99 ml. distilled water + 1 ml. 1 per cent KOH. Of this add 20 ml. to 80 ml. distilled water.

Various applications to milk are described by the author.

A.T.R.M.

POULTRY HUSBANDRY

Economics

The increased costs of feedingstuffs during the last few months have compelled many poultry keepers to take a real interest in the economics of poultry-keeping. Their anxiety over the immediate future has intensified that interest. Unfortunately, poultry keeping is usually very much a subsidiary section of the general farm and surveys of the costs and profits of poultry enterprises are not common. A good deal of interest, therefore, attaches to a recent publication by the Department of Agricultural Economics of the University College of Wales entitled "Financial Results of 34 Poultry Enterprises in Wales 1947-8" by W. D. Jones.

The study is particularly interesting because it relates to small flocks, and most of this country's flocks are in that category. The flocks investigated ranged from 35 to 300 laying birds but the average was 145. Flocks of this size would not be regarded as specialist undertakings, and would by no means require the full-time services of even one man. It is therefore interesting to learn that the labour charges averaged 6s. 9½d. per bird, which is much higher than the figure usually attributed to specialized undertakings and suggests, in this respect, that the small flock is not a very economic user of labour. But against this shortcoming must be set the average food charge which is assessed at 15s. 9d. per bird. Of the food consumed, 44 per cent was home grown. On the basis of the costs stated by the author and with an average egg yield of 122 eggs per bird, the profit per bird amounted to 23s. 10d. These figures make an interesting commentary on the relative efficiency and profitability of general farm flocks and those of the specialist. It must not be forgotten that these costs relate to a period before the introduction of seasonal egg prices and, while they illustrate matters where the small flock compares unfavourably with the specialized unit, they undoubtedly reinforce the argument of the lower food costs of the general farm flocks.

Cleaning and Storage of Eggs

Post-war realization that quality standards for agricultural products including eggs must be regained is reflected in an increasing interest in grading, packing and marketing problems. E. M. Funk, in a paper entitled " Experiments in Cleaning Soiled Eggs for Storage", *Research Bulletin* 426 (1948), published by the University of Missouri, deals with the differing rates of deterioration during storage of eggs cleaned by several methods. It is demonstrated that soiled eggs keep better than eggs washed in cold water or water below 100°F., and it is maintained that dry cleaned eggs do not keep well in storage. The author concludes that the most effective means of preventing spoilage in eggs is by the process of thermo-stabilization. This involves complete immersion in water or oil at a temperature over 100°F. for several minutes. To be effective the heat must penetrate the egg.

A paper which is concerned with the storage of eggs for incubation is published in *Poult. Sci.*, 1949, **28**, 731-8, entitled " Effect of Shipment on Pre-Incubated Fertile Eggs" by M. W. Olsen. The author demonstrates that eggs incubated for 18 hours and then cooled for 2 hours at 55°F. showed no difference in hatchability after considerable travelling when compared with fertile eggs retained and incubated in the area of production.

Feeding and Management

The introduction of seasonal prices for eggs in this country has stimulated interest in management methods leading to higher winter production. In this connection Bulletin 222 by H. B. Hinds, " Environmental Factors and their Effect on the Natural Egg Cycle," published by the University of Arizona, 1949, will be of practical interest. The bulletin gives an account of the effect on the egg production cycle of changes in temperature and light. The author makes several general statements, amongst which are the conclusions that continuous light does not stimulate food consumption or the production of a greater number of eggs, but that air conditioning the house, i.e. ensuring even temperature all the year round, produces uniform distribution of lay over most of the year. The author casts doubt on the justification of the use of confinement (e.g., batteries) as a factor in increasing egg production or leading to more even distribution of production. It should, however, be realized that the author's conclusions relate to conditions in Arizona. As he also states that laying is adversely affected by sudden changes in temperature, it seems probable that confinement to ensure greater evenness of temperature, and so more even production, would be of practical worth in this country.

There are a number of useful contributions on nutritional matters which can only be briefly dealt with in this issue.

Bulletin 280 (1947) by P. J. Serfontein, published by the Department of Agriculture, Union of South Africa, deals with " Blood Meal in Poultry Rations". The author gives a warning on the limitations of blood meal as a source of protein for poultry. In chicks it can be used to replace 25 per cent of the protein of white fish meal or 25 per cent of

the protein of meat meal, although its combination with the former is more effective. Where blood meal was used as the sole source of animal protein, cannibalism became rife.

" The Phosphorus Requirements of the Chicken" (Bulletin No. 260, April 1948) by E. P. Singsen, and published by the Storrs Agricultural Experiment Station, Connecticut, is an extremely informative bulletin on the value of phosphorus from various sources in the diet of poultry at various ages. The author gives particular attention to the use of phytin-phosphorus—phosphorus from vegetable sources—and deals with the optimum levels of vitamin D for quantities of phosphorus supplied from several sources.

A useful bulletin on a matter closely connected with the marketing of poultry products is the U.S. Department of Agriculture Circular 803, published February, 1949, entitled " The Feathers from Domestic and Wild Fowl " by J. I. Hardy and T. L. Plitt Hardy. The bulletin deals with the classification and use of feathers from various classes of poultry. Mention is made of methods of cleaning feathers and the use of apparatus for testing feathers for their suitability for various uses.

R.C.

CROPS AND PLANT BREEDING

Sterility in Smooth-awned Barley

One way of reducing the nuisance value of barley awns is to breed smooth-awned varieties. If, however, the smooth-awned parent used is Lion or a derivative of it, all the smooth-awned forms lack hairs on their stigmas, and are therefore liable to sterility resulting from defective pollination. Woodward (*Agron. J.*, 1949, **41**, 430-4) has studied this phenomenon in detail in the American variety Velvon. He finds that when the sterility affects more than 25 to 30 per cent of the florets, it causes reduction in yield. The degree of sterility varies from year to year and is slightly less in late-sown crops. Another variety, Wisconsin Pedigree 38, has smooth awns and hairy stigmas, and would appear to be a better potential parent in the breeding of smooth-awned varieties.

Vernalization of Winter Cereals

Hänsel (*Bodenkultur*, 1949, **3**, 1-41 and 215-28) has reported interesting results from vernalization studies on winter wheat and winter barley varieties. In one experiment, incomplete vernalization (15 days at 2° to 0°C.) was followed by a late March sowing and the numbers of plants heading were counted on four successive dates. In some varieties, all plants had headed by the first date, while in others none had headed by the last date. The intermediate varieties each showed a spread of heading dates, from which the author concludes that, in spite of their apparent uniformity when grown in the normal way, they are made up of different physiological lines. He has not, however, confirmed this by selecting lines which behave more uniformly.

In another experiment the cold requirement of five varieties of winter barley was studied both by bringing plants from the field into a greenhouse at successive dates through the winter and by vernalization treatments varying in length. Tschermak's two-row winter barley fulfilled its cold requirement in the field by mid-December and 20 days' vernalization was enough to induce half the plants to flower. At the other extreme, Friedrichswerther Berg and Peragis 12 needed 35 to 40 days' vernalization and in the field did not fulfil their cold requirement until early February. It is argued that varieties like Tschermak's would, other things being equal, be the less winter-hardy.

Physiology of Polyploids

By using colchicine it is fairly easy to make polyploids in most species and theoretically possible in any, but it is very difficult to make any general statement about their possible value for cultivation. Any generalization which can be discovered is therefore of special interest to plant breeders. Schwanitz (*Züchter*, 1949, **19,** 221-32) has studied the water relations and morphological characters bearing on them in a wide range of induced tetraploids, in comparison with their parent diploids. From his morphological studies he concludes that tetraploids should transpire less water than their parent diploids. In transpiration experiments he found that this was the case. The difference was accentuated when external conditions favoured high transpiration rates. Since neither high nor low transpiration rates can be regarded as unmixed blessings, this discovery throws light on the puzzling inconsistencies of behaviour of tetraploids ; if confirmed, it will greatly assist in interpreting the behaviour of polyploids and in assessing their practical value.

Inheritance of Injury by 2, 4-D

Rossmann and Sprague have reported some vitally important work on a carry-over of 2, 4-D injury to the next generation in maize (*Pl. Physiol.*, 1949, **24,** 770-3). In 1947 spraying with 2, 4-D was carried out on 4 inbred lines and the 12 possible single crosses between them, at any one of three stages of growth—(1) 6-8 leaf stage (2) emergence of tassel and earshoot (3) 10 days after pollination. In some cases injury was so severe that there was not enough seed produced for a further generation, but the seed from survivors was used in 1948 to plant a 7×7 lattice square experiment to test the effect of the 1947 treatments. Significant reductions in yield were detected, the biggest reductions being 5 to 8 bushels per acre. The losses in yield were associated with reductions in stand, which would have been greater still if they had not planted extra seed. That the reduction is not simply due to direct injury of the seed is shown by the fact that the greatest loss in yield followed treatment of the parent at the 6 to 8 leaf stage. It is known that 2, 4-D produces injury in our cereals (wheat, barley and oats) ; the warning given by this experiment is therefore a warning to us as well as to maize growers.

Dormancy in Potatoes

A rather similar warning is conveyed by Gandarillas and Nylund (*Amer. Pot. J.*, 1949, **26**, 7-16). They studied the value for seed purposes of potatoes which had been treated with the methyl ester of naphthalene-acetic acid (MNA) to prolong dormancy and subsequently had had their dormancy broken by treatment with ethylene chlorhydrin (EC). Their treatments comprised 4 dates of MNA application, 3 dates of EC treatment and two storage temperatures ; a factorial design was used in the field. It was found that MNA treatment reduced yields by about a quarter. Slow emergence and reduced number of stems per seed-piece seemed to be the main causes of the reduction. Treatment with EC, especially the latest treatment (6 days before planting), gave a detectable increase in yield with MNA-treated seed, but the increase was far from adequate to counteract the harmful effects of the MNA treatment.

A very good review of general problems of dormancy in potatoes and reports of his own original work is given by Emilsson (*Acta Agric. Suecana.*, 1949, **3**, 189-284). He distinguishes between rest period and dormant period. During the *rest period*, tubers will not sprout even under storage conditions optimal for sprouting. The rest period is a remarkably constant characteristic of the variety concerned and ranges in different varieties from 5 to 19½ weeks. It is not correlated with earliness, is less in mature than in immature tubers, not affected by daylength, less in larger than in smaller tubers, is reduced by blight infection, and is not consistently affected by manuring. The rest period is probably shortened by storage at 0°C. or 20°C., as compared with 5°C., and is reduced by storage at 100 per cent humidity, compared with 60 per cent.

During the *dormant period* the tubers may be stored at a temperature below the optimum for sprouting without beginning to sprout or break down. This also is a varietal characteristic and ranges in duration from 18 to 33 weeks. In contrast to the rest period, early varieties tend to have shorter dormant periods. The biochemical processes associated with dormancy were also investigated and discussed.

Sugar Beet Spacing

A review on this topic by Coons (*Proc. Amer. Soc. Sug. Beet Technol.*, 1948, 252-65) shows that the American agronomists are coming round to views long current in Great Britain, namely that the highest yields are obtained from the highest populations, with the qualification that the distribution ratio (row width/row interval) should not exceed 2. The most convincing evidence of this comes from a study by Lill (mimeographed) on factory samples. From the weight of the sample, the number of beets in the sample and the recorded yield and area of the crop from which the sample came, it is possible to determine, over a range of crops, the relation between yield and population per acre. Lill studied data relating to 5,605 fields over a period of five years. The populations ranged from 6,245 to 24,244 per acre, the distribution

centring around 14,000 per acre. He concluded that (a) the relation between population and yield varied only slightly with season and that yields were highest when populations were highest; (b) width of row had a slight but definite effect, favouring narrower rows, which gave higher populations and yields; (c) the relation between yield and population is essentially linear; (d) many fields had populations so low that they could only give half their possible yield.

Root Weight of Flowering Beets

Fife and Price (*Proc. Amer. Soc. Sug. Beet Technol.*, 1948, 196-203) by studies on sugar beets which had overwintered in the field, have provided rather strong evidence that when the plant enters its reproductive phase and bolts, the root abruptly stops increasing in weight.

Performance of Sugar Beet Strains

A summary of the performance of sugar beet strains in tests by the National Institute of Agricultural Botany is given by Thompson (*Brit. Sugar Beet Rev.*, 1949, **18**, 31-2). He gives tables showing the yield of beets, sugar content, yield of sugar, yield of tops and percentage of bolters. Kleinwanzleben E still seems to lead the field.

Clover Seeds

Isely (*Iowa State Coll. J. Sci.*, 1948, **23**, 125-36) gives a concise, accurate and well illustrated account of the features of seeds of the common *Trifolium* species.

J.L.F.

CROP HUSBANDRY

Types of Rape

Now that brassica crops for feeding to livestock are receiving more attention in this country, the ideas of J. H. Claridge, an agronomist of the Department of Agriculture, Wellington, N.Z. (*N.Z. Journal of Agriculture*, July, 1949, 77) on their findings in regard to types of rape are interesting, especially as rape is such a valuable crop to the N.Z. farmer for fat lamb production and might possibly have extended value here.

Reference is made to the fact that the original imported stocks were very inconsistent. Investigations were begun about 1930 and resulted in the identification of three main types of rape then being imported, namely *Giant*, *Broad-leaf Essex* and *Swede-like*. In 1935 quantities of pure seed of *Giant* and *Broad-leaf Essex* had been raised and were passed

over to commercial firms to multiply under the Department of Agriculture's certification scheme. By 1940 the production of rape seed under certification covered the whole of the Dominion's requirements and since then no rape seed has been imported—in fact some seed is now exported. The growers show a decided preference for the broad-leaved Essex-type and an improved type of this has been bred and marketed.

The New Zealand seed certification scheme has now made available to the farmer three distinct strains of certified rape seed :

1. *Certified Giant.* A high-producing type showing very little recovery after grazing, which has been developed by plant selection.
2. *Certified Broad-leaf Essex.* A type developed by hybridization, which gives a good initial yield and has the ability to recover after grazing.
3. *Certified Club-Root Resistant.* A strain of rape of the Giant type showing pronounced resistance to attack by club root.

Husk Percentage of Oats

For many years, N.I.A.B. Recorders at sub-stations have carried out as a routine job husk percentage determinations on all oat varieties grown in trials and observation plots. A mass of interesting varietal data has been built up. Work on these lines has also been undertaken at the Cereals Research Station, St. Albans, in Scotland and elsewhere.

An article on " Grain size and hull percentage as Factors in the Milling Quality of Oats " (Peek, J. M. and Poehlman, J. M., *American Soc. of Agron. Journal*, October 1949, 462-6) gives interesting material on this subject. Fifteen varieties and experimental selections were grown at five locations in Missouri in 1946 and are compared for milling quality. The oats are divided into five grain sizes ; large, stub, slim, small and double, according to practice in a commercial oat mill. The value of the various sizes is discussed. The milling process as now performed for these test lots is tedious and time-consuming and limits the number of samples that can be studied. This operation could be speeded up by the development of a simple-impact type of experimental huller which would effectively remove the hulls from the groats. Such a machine would be extremely useful in this country, too, for many workers in various walks of life, i.e. plant breeder, field worker, seedsman, miller, etc.

Oat Varieties

New Zealand views on some of the oat varieties we know well in this country make interesting reading (*N.Z. Journal of Agriculture*, July 1949, 35). The milling oats most favoured are *Garton's Abundance* and *Garton's Onward*. We would agree to the former but not the latter, which is very thick skinned in this country. Reference is made to straw-break of *Onward* (common in this country too) and to excessive lodging of *Abundance*. *Spitfire* and *Royal Scot* are apparently gaining favour. They observe that *Royal Scot* is prone to " blast " or " white heads", a condition which shows as unfilled glumes on the panicle.

Chemical Weed-Killers

A note on this very topical subject in *N.Z. Journal of Agriculture* for July 1949 makes interesting reading in relation to our own advice on this matter. It notes that even the so-called " selective " weed-killers will damage a wide range of crops.

Power Kerosene can be used on carrots and parsnips only. All other crops will be severely damaged or killed. The kerosene should be tested on a small patch, as some lines will damage carrots. Spraying should be made after the first fernleaf appears and not later than the 4-fern-leaf stage if tainting is to be avoided.

DNOC is satisfactory with cereal crops, linseed and linen flax but none of these crops should be sprayed in the early seedling stage.

" Hormone " Type in water solutions are safer to use in cereal crops (after they are 6 to 8 inches high), grass, seeds crops, linseed, linen flax, potatoes and maize. In all cases, light rather than heavy applications per acre should be used. Oil-based solutions of " hormone " weed-killers should not be used on crops, as they are more liable to cause injury than water solutions.

Brassica Crops. Turnips, swedes, cabbage, rape, chou moellier and kale are all highly susceptible to damage by " hormone " weed-killers, DNOC or power kerosene, and must on no account be sprayed.

In all cases, but particularly with DNOC compounds, the weeds are more susceptible as seedlings. Crops are also more susceptible to damage when young and must not be sprayed in the early seedling stage.

G.E.F.
D.H.R.

VEGETABLES

Effect of Spacing on Certain Vegetables

Wilson, A. C. (*Utah Acad. Sci. Arts and Letters*, 1934, **11**, 177) found that thinning stimulated formation of double onions and bottle-necked onions.

Bremer, H. (*Angew. Bot.*, 1936, **18**, 204) confirmed this in Europe.

Landau, N. (*Nature*, 1949, **164**, 496) now reports that the inside rows in experimental onion beds show only 4.2 per cent bolters compared with over 6 per cent in the outside rows. He attributes this to the effect of more light on the outer rows.

Warne, L. G. G. (*Nature*, 1949, **164**, 969) finds fewer bolters at close spacing in both beet and carrot, and in shallots the number of flower heads per plant was smaller at closer spacing. He considers that the effect is not due to light but to more rapid vegetative growth at wider spacings. In the case of fast-growing shallots at wide spacing, more heads will actually have emerged before general suppression by lengthening days. In the roots, rapid growth at wide spacing enables a larger proportion of potential bolters to bolt in fact by any given date.

The abstractor (unpublished results) has found that curding and bolting of cauliflower are inhibited in proportion to confinement of the roots.

There is need for detailed investigation of the effect of spacing on date of maturity and bolting of vegetables, especially in relation to manurial status and developmental age of the plants when thinning or transplanting is carried out.

Control of Truffle in Beds of Cultivated Mushrooms. Kligman, A. M. (*Phytopath.*, 1944, **34**, 376.)

Following a detailed investigation of the truffle fungus (*Pseudobalsamia microspora*) in relation to mushroom culture, the author concludes that soil is the primary source of infection. It is not practicable to kill the spores in soil by steam or any of the usual fumigants.

There are several routes by which spores may enter the mushroom beds :

1. Spawn may be contaminated by infected soil during manufacture. Nowadays stringent precautions render this source unlikely.
2. The composting soil may be infected. To improve the physical condition of compost, it is recommended that gypsum (20-30 lb. per ton) be added instead of dry soil.
3. The composting site may be contaminated. Only a hard dry surface should be used, never growing sod or freshly cleared ground.
4. The casing soil may contain spores. Ordinarily spores brought in at casing time will not germinate because of the relatively low temperature of the beds at this stage, but they may infect the following crop.

Truffle spores do not germinate below 60°F. and if the beds are kept at this temperature, a normal, though slow, set of mushroom spawn can be obtained. The loss of time is more than offset by freedom from damage.

The author admits that it may be difficult to convince growers that the truffle does not spread from bed to bed. Infestation of a whole house is usually due to a common widespread source of infection.

It is impracticable to sterilize the truffle fructifications on the beds because the extremely resistant spores are situated deep in the ascocarps ; nor is this necessary, for secondary infections do not normally occur.

Closely compacted beds with surface infection only, can sometimes be brought back into mushroom production by drying out for three weeks. This treatment kills superficial truffle mycelium but not the deeper-seated mushroom. Naturally, if the infection itself is also deep-seated, this treatment will be ineffective.

Trenching round infected beds serves no useful purpose. When infected beds are removed, they should be dumped as far away as possible from the mushroom houses. No effective fungicide for after use is known.

The author recommends control of truffle by growing the mushrooms at low temperature.

Note. The " truffle " discussed here is entirely distinct from the edible truffle (*Tuber* sp.).

E.J.W.

The Effects of Grazing on the Balance Between *Erica cinerea* L. and *Calluna vulgaris* (L.) Hull in Upland Heath and their Morphological responses. Gimingham C. H. *J. Ecol.*, 1949, **37**, 100-19.

After severe burning the regeneration of *Erica* and *Calluna* was almost entirely from seed and seedling establishment of *Erica* was consistently higher than *Calluna*. Without grazing, *Erica* maintained a consistently greater weight per unit area. The influence of grazing, carried out at various intensities, was to shift the balance in favour of *Calluna* when grazing was approximately between the limits of one and four sheep to the acre. At greater intensities of grazing, *Calluna* appeared to drop out more rapidly than *Erica*.

The differential responses of the two species to grazing was investigated in pot experiments, involving the cutting back of developing plants at different ages. The marked differences shown by the species in their development and response to these treatments would explain their field behaviour.

Seeds of both species germinated freely, *Calluna* in the dark, but *Erica* requiring light. For about 12 weeks after germination both species grew from a single active apex. At this stage *Calluna* was approximately 1 cm. in height and lateral branches were formed in the axils of one of the sixth to tenth pair of leaves. Subsequent to the development of the first pair of laterals, others appeared at short intervals up the stem producing a " spruce-like " form. When the plants were about 21 weeks old, the buds in the axils of the few pairs of leaves at the very base of the plant and below the first-formed laterals developed and gave rise to a dense tuft of young branches. The first-formed laterals at this stage grew more rapidly than the remainder and gave rise to horizontal and spreading branches. The two types of laterals, the ones giving rise to prostrate branches and the others giving rise to bushy growth below, were of importance in determining the response of the plant to cutting.

Erica in its growth produced laterals at a slightly later stage than *Calluna*. These were not so regularly produced as in *Calluna*, and, after growing obliquely outward for a short distance, turned more or less vertically upwards. The growth of laterals in *Erica* was less regular and fewer in number, giving a loose, bush-like form. At the end of one season's growth *Calluna*, through its growth form, produced more ground cover.

The influence of cutting of the leading shoot of *Calluna* before laterals were formed, depended upon the age or the level at which the cut was made. If such cutting were above the level of the buds which produced the spreading laterals, such branches would be immediately formed and the bush-forming laterals from the lower axils would later develop. If the leading shoot were cut at a lower level, only the bush-forming laterals developed. Thus, depending on the severity of cutting, two distinct plant forms were produced in *Calluna*.

Similar cutting of *Erica* did not materially alter the morphology of the plant, although repeated cutting produced a slightly denser bush. Repeated cutting of the laterals of *Calluna* did not produce different forms but tended to emphasize that form, determined by the initial cutting of the leading shoot.

Medium cutting, as represented by cuts above the buds producing the spreading laterals in *Calluna*, would, in the field, give advantage to this species over *Erica* by its greater shade-producing habit. Verification of the influence of cutting on growth form and its influence on the competitive ability of the two species, was verified in the field by a census of the growth forms which appeared in the plots grazed at different intensities. Without grazing, the erect growing form of *Calluna* developed, which showed no competitive advantage over *Erica* and the proportions of spreading and bush types were low. Medium and heavy intensities of grazing produced a higher proportion of spreading and bush types, with the latter more prominent under the heaviest intensities of grazing. The appearance of spreading types of *Erica* in the field was negligible, while the proportion of erect and bush forms were respectively related to slight and heavy grazing. It would thus appear that the relative competitive ability of these two species under grazing conditions, is dependent upon the intensity of grazing which has its influence through the growth form produced; intensive grazing, which gives rise to the prostrate spreading forms of *Calluna*, conferred increased competitive ability on this species in comparison with *Erica*.

A Statistical Investigation into the Distribution of *Holcus mollis L.* and *Deschampsia flexuosa* (L.) Trin. Jowett, G. H. and Scurfield G. *J. Ecology*, 1949, **37**, 68-81.

The distribution in relation to edaphic conditions of *Holcus mollis* and *Deschampsia flexuosa* was studied in four woodlands near Sheffield which afforded the widest range for type. *Deschampsia*-dominated situations within these woodlands had a soil *p*H value less than 3.75 and *Holcus*-dominated soils a *p*H greater than this value. *Holcus* occurred more frequently in the moister situations while *Deschampsia* preferred a more highly organic substrate. Observations indicated that *Deschampsia* is an earlier colonizer of raw woodland soils than *Holcus* which is evidence that there is a progressive soil change involving decrease in organic matter, an increase in moisture relative to organic matter and an increase in *p*H value. It is suggested that such changes may be brought about by the influence of microflora during and after the growth of *Deschampsia* or that this species may, by root action and shedding of aerial portions, initiate changes in organic matter and soil moisture conditions conducive to the establishment of *Holcus*.

T.E.W.

NUTRITION OF HORTICULTURAL CROPS

Nutrient Solutions

Nutrient solutions in horticultural practice have a wide application and it seems likely that increasing attention will be paid to supplying nutrients in soluble form which plants can absorb through their roots, branches or leaves. The greatest scope for such work is where crops are grown by soilless culture. On the other hand, simple solutions of one or more nutrients can be successfully applied for increasing crop yields well above average levels or simply for correcting glaring deficiencies which soil treatment is at a loss to remedy.

Soilless Culture, Templeman, W. G. *Sci. Hort.*, 1949, **9,** 62-6.

The practice of growing commercial crops by soilless culture is described under two headings. The first deals with solution culture which involves suspending the plants in wire netting baskets containing litter over a shallow tank of nutrient solution. This system has been developed successfully by Gericke in America but extensive tests in this country have not proved the method suitable. The second process mentioned involves sand or aggregate as a rooting medium with five devious systems of supplying nutrients. These are: (1) surface-watering, (2) automatic dilution surface watering, (3) drip culture, (4) sub-irrigation and (5) dry application. Each particular system has its advantages, but for space-saving and elimination of storage tanks No. 2 is recommended. Descriptions are given of solutions containing major and micro-nutrients which can be made up from fertilizer-grade materials. Two technical points, involving the maintenance of the solution at *p*H 6.0 and supplying the bulk of the nitrogen as nitrate, are stressed.

The advantages and disadvantages of soilless culture are succinctly tabulated, particular importance being attached to the technical aspect of the work compared with growing plants in soil.

Plant Injection Methods, Roach, W. A. *Sci. Hort.*, 1949, **9,** 55-61.

The diagnosis and cure of plant nutrient disorders by plant injection methods depends on the ability of the plant to absorb solutions from cut surfaces. Furthermore, these solutions are distributed in such a way that by knowing the exact position to inject, one half of a leaf can receive a particular nutrient or nutrients whilst the other half remains as a control.

Various methods are described including (1) interveinal injection, (2) leaf-tip injection, (3) leaflet stalk injection, (4) leaf stalk injection and (5) branch injection. In all the methods described, actively growing leaves are essential for satisfactory working conditions. Responses in colour to injected solutions can be seen in as little as two days, but generally the time lag is from seven to ten days.

The application of these methods under field conditions is dealt with for a wide range of circumstances in order to illustrate the value of the technique as opposed to other diagnostic methods. The author points

out that when effective diagnosis has been made, corrective treatment may involve injection of a solution or of solid tablets. In the case of sprays, application to the foliage may be done in spring or summer, or to the branches in winter. Subjects mentioned include boron deficiency in apples; manganese deficiency in cherries; multiple deficiencies of manganese, iron, zinc and boron, and calcium-magnesium deficiencies in potato.

Complementary to all injection work is the chemical analysis of the leaf and the recording of yield and quality of crop. W.P.

FRUIT

Biennial Bearing

Many fruit trees suffer from a cropping rhythm in which a heavy crop, usually of overcrowded small fruit in one year, called the " on " year, is followed by little or no crop in the next year, the " off " year; this cropping in alternate years is known as " biennial bearing " and is a serious problem in this country with certain varieties of apple. The problem has been under investigation at East Malling Research Station for some years and recently a series of three papers by L. B. Singh has appeared, which reveals important advances.

The first of these ([1]) reviews the literature on the subject, covering some 125 contributions. It deals in turn with the economic importance of the biennial habit, methods of measuring the regularity and intensity of the fluctuation, the causes of it and attempted control measures. In this brief review the first three headings will be passed over and a little space given to the seven attempted control measures that are described.

1. Fruit Thinning To reduce the trouble, thinning must be done early and there is then a risk that it may be too severe to allow a useful crop to mature.

2. Blossom Thinning The removal of a proportion of blossom from an " on " year tree may be effective in controlling biennial bearing but it is difficult to get just the right degree of thinning, which varies from variety to variety. Blossom thinning by hand is very laborious and various sprays have been used experimentally.

3. Pruning Various treatments are suggested of which spur reduction before the " off " year appears to be the most promising.

4. Nitrogen Manuring There is some evidence that nitrogen applied in the early spring of the " off " year may reduce the tendency and also that the regular application of farmyard manure may partially correct the trouble.

5. Defoliation The removal of a proportion of the leaves in the " off " year may reduce the overproduction of fruit bud. It has been suggested that there is a relationship between leaf-area and blossom bud development, that a flower-producing substance (such as a hormone) is produced by the leaves and moved away from the buds until the requirements of other parts are satisfied, and that the active leaf area needed to form this substance may vary with variety.

6. Conservation of Soil Moisture at Critical Times There is some evidence that dry soil conditions in spring favour bud formation.

7. Ringing The slowing down of elongation growth and the accumulation of starch as a result of ringing may aid flower bud formation. The effect is, however, likely to be transitory.

The second paper (2) gives an account of detailed records made on 36 bush trees of Miller's Seedling apple, a variety notorious for biennial bearing. The trees, which were some 30 years old, were all blossoming profusely in 1945 after the severe spring frost of 1944 and nine of them were deblossomed completely so that they blossomed in 1946 when the other twenty-seven were devoid of blossom. As a result it was possible to make close comparisons between " on " and " off " trees under identical conditions in the following seasons. It was found that deblossoming produced an abnormal " off " year in the season in which it was done, and that such trees made more growth than " on " year trees, unlike the normal " off " year trees observed in the following season, which made slightly less growth than comparable " on " year trees. The most consistent difference in tree vigour was shown by trunk thickening, which was depressed in the year of cropping. A similar effect on root growth was observed on trees of Lane's Prince Albert. The records relating to spurs and spur leaves were specially interesting. The total leaf area per spur of " on " year trees was about half that of " off " year trees during the critical months of May and June when fruit-bud differentiation is taking place. This deficiency of leaf area appears in Miller's Seedling to be responsible for the failure of the bourse buds, produced below the fruiting clusters in the " on " year, to develop into fruit-buds for the following spring, thus resulting in lack of blossom and crop. Under certain conditions, however, as for instance with Blenheim Orange grown as a cordon, only a few fruit buds may be formed in spite of the presence of abundant large leaves. Regular cropping varieties, such as Ellison's Orange and Ribston Pippin, on the other hand, formed bourse buds that usually developed into fruit buds each year, probably because the leaf area per spur at the critical period was adequate. The spurs may, to quite a large extent, behave as individuals, a few flowering when the majority are leafy only and vice versa, although the trees as a whole may be in an " off " or an " on " year condition.

The third paper (3) describes certain experiments on control measures. In the " off " year, treatments to reduce the leaf-area were tried in the hope that this would lessen the formation of fruit buds for the following " on " year. One series of treatments on Miller's Seedling and Early Victoria consisted in defoliating by hand individual branches of an experimental tree at different times and to varying degrees. Although some reduction in shoot growth and in fruit buds on defoliated branches was observed the differences were not significant and sufficient fruit bud was formed to produce a heavy crop of fruit. The possible effect of one treated branch on another may, however, be responsible for the lack of a clear-cut result and an experiment on whole trees was begun in 1947 and is still in progress.

Defoliation by hand is very laborious, therefore defoliation by spray was also tried, using sodium chlorate, copper sulphate, tar oil and lime sulphur applied at various concentrations on May 10, 1946, to a series

of three-year-old trees of Cox's Orange Pippin and McIntosh Red. Scorching showed up two days after spraying, being most severe where sodium chlorate had been used; here most of the leaves on the trees withered and died even when the concentration used was as low as 0.05 per cent. With copper sulphate small brown spots were produced, with tar oil the scorching was in patches but lime sulphur caused little visible injury even at 4 per cent. Fruit buds on these young trees were naturally rather few but counts revealed that the number formed after lime sulphur treatment was the same as on control trees, whereas no fruit buds were formed after sodium chlorate; trees treated with copper sulphate or tar oil fell between these extremes. This line, therefore, seems to have promise.

Treatments in the " on " year were aimed at reducing the crop to be carried; they consisted of bud-rubbing (the removal of complete fruit-buds) and blossom thinning (the removal of the blossom trusses only). The experiments described related to treatments on individual branches on four trees of Miller's Seedling but whole trees were treated in the year following and a report on the results should appear in due course. On the branches, bud-rubbing was done on March 28, 1946 at bud-burst, all the fruit buds being broken off by hand from two out of every three successive complex spurs and all but one bud from the third. This resulted in the removal of some 86 per cent of the total fruit buds. Blossom thinning was done on certain other branches on April 17, 1946, fifteen days before full-bloom, at the pink-bud stage. The blossom clusters were thinned out to the same extent as in the bud-rubbing, the clusters being pinched out by hand leaving the rosette leaves. Detailed records on leaf development, shoot growth and cropping were taken and these were supplemented by serial photographs showing the sequence of development at monthly intervals throughout the season. The increased leaf-area on the treated spurs was especially notable and both treatments produced a useful crop of good quality fruit for two years in succession, with a promise of a further satisfactory crop in the following year. The author suggests that a less drastic thinning might be as effective in producing regular cropping.

Note on the Control of Magnesian Deficiency in Apples. Wallace, T. *Long Ashton Res. Sta. Ann. Rept.*, 1947, 58-61.

In the original abstract of this paper the following sentence occurred : " Magnesian limestone was ineffective and is not recommended." It should read as follows : " The growth effects from Magnesian limestone were relatively small."

H.B.S.M.

References

1. Studies in Biennial Bearing. II. A review of the literature. Singh, L. B. *J. Hort. Sci.*, 1948, **24**, 45-65.

2. Studies in Biennial Bearing. III. Growth studies in " on " and " off " year trees. Singh, L. B. *J. Hort. Sci.*, 1948, **24**, 123-48.

3. Studies in Biennial Bearing. IV. Bud-rubbing, blossom-thinning and defoliation as possible control measures. Singh, L. B. *J. Hort. Sci.*, 1948, **24**, 159-77.

FLOWERS

Effect of After-harvest and Pre-cooling Temperatures on Iris. Stuart, Neil W., *et al.* *Florist's Review*, July 28, 1949.

Bulbous Iris, variety Wedgwood, were lifted on July 22 and August 5, graded into 8, 9 and 10 cm. sizes, and stored for three and five weeks at 75° and 85°F. After these curing periods, bulbs from all twelve lots were stored for 12 weeks at 65°, 50°, 45° and 40°F., before boxing and forcing gently at a night temperature of 55°F. Dissection of sample bulbs showed no flower formation with any treatment at the time of planting, but 10 cm. bulbs which had been cured at 85° and pre-cooled at 65° had fully differentiated flowers two weeks after planting.

Earliest flowering (mid-December) was obtained from 10 cm. bulbs cured at 85° and pre-cooled at 50°F. After-harvest curing, followed by storage at 65° or 50°F., increased earliness of flowering in all cases. As might be expected, the number of " blind " (non-flowering) bulbs was greatest in the 8 cm. lots and least in the 10 cm., and blindness was increased by pre-cooling below 50° but considerably reduced by curing at 75° or 85°F before cooling. The bulbs lifted on July 22 cured more effectively than those lifted August 5. Stem length was not greatly affected by any treatment, but stem weight was greater with larger bulbs and was reduced by pre-cooling below 50°F.

It would appear from these results that the production of good quality Iris flowers for the Christmas market should be a practical proposition by lifting in late July, storing for three weeks at 85°F. and then for twelve weeks at 50°-65° F. before boxing.

Leaf Burning of Croft Easter Lilies Linked to Nutrients. Stuart, Neil W. *Florist's Review*, July 7, 1949.

A tipburn or spotting of leaves of Croft Easter lilies (*L. longiflorum*) during forcing has been frequently reported in the U.S.A. The symptoms, which resemble both Botrytis blight and nicotine scorching, occur usually just on the margins of the leaves an inch or two from the tip, and are most frequently confined to leaves on the upper part of the plant. The spots are often half-moon shaped at first, but may increase in size until the entire tip of the leaf is brown and dry. The spotting is most severe on plants with light-coloured, nitrogen-deficient leaves and on those that are forced rapidly. The lower leaves on such plants are usually dead by the time the plant flowers. The trouble was at first thought to be due to Botrytis attack, but the fungus could not be isolated from affected leaves.

The paper describes extensive fertilizer trials in soil and sand, coupled with chemical analyses of leaves. The results, though not finally conclusive, support the hypothesis that the symptoms are primarily due to magnesium deficiency, though applications of magnesium fertilizer alone do little to correct the trouble. The author concludes that, as in other cases, nitrogen and magnesium uptake are closely linked and that potassium decreases magnesium absorption. The application of sodium nitrate or ammonium sulphate alone or with magnesium sulphate greatly

reduced the trouble, but the use of complete fertilizers containing potassium increased it. Any drying-out of the plants during forcing also tended to increase the incidence. The preliminary recommendations are therefore made to apply nitrogenous fertilizers and to syringe plants regularly.

This paper may be of interest to advisory officers in this country, as somewhat similar symptoms are known to occur on forced lilies, and trials on these lines might be fruitful.

R.H.S.

GLASSHOUSE CROPS

Blotchy Ripening in Tomatoes. (Experimental and Research Station, Cheshunt, Herts. *Annual Reports* 1947, 1948 and earlier.)

Of all the physiological disorders which affect tomatoes, that known as " blotchy ripening " probably causes the greatest financial loss to growers. It is recorded in trials carried out at Cheshunt from 1921 onwards when the variety *Kondine Red* showed much greater susceptibility than *Comet*. It was shown that deficiency of potash increased susceptibility to blotchy ripening, but that in these varieties a deficiency of nitrogen was also a determining factor. In 1926 it was reported that a dry subsoil predisposed tomatoes to the trouble, and that a dry subsoil could not be corrected during the growing season, but only by thorough winter flooding.

In 1934 and 1935 it was shown that the red pulp from " blotchy " fruits contained 5.7 per cent more potash (as K_2O) than the yellow pulp from the same fruits. In 1939, in an experiment planned to compare different manurial treatments after steaming, plots receiving potash produced only 2.7 per cent blotchy fruit with a total crop of 39.9 tons per acre, whereas the plots which received hoof and horn, bone meal and stable manure, in addition to sulphate of potash, gave 4.3 per cent blotchy ripening and a yield at the rate of 35.9 tons per acre, 4 tons per acre lower.

During that year, the results from the " deficiency " houses are of interest. In the control plots, after 24 years with the same treatment (i.e. complete artificials plus stable manure), 3 per cent of the total fruit was affected by blotchy ripening, whereas where potash had been omitted, the amount of blotch increased to 62 per cent and where no fertilizers at all had been applied, it was 71 per cent.

A trial in 1942 to compare sulphate of potash with muriate of potash as a base dressing, emphasized very strongly varietal susceptibility to blotchy ripening. *Potentate* with muriate of potash produced an average of 5.08 per cent blotch compared with 0.52 per cent in the variety *E.S.*1. With sulphate of potash, the figures were *Potentate* 5.2 per cent and *E.S.*1. 0.88 per cent. In separate variety trials that year, *Potentate* gave 6.01 per cent " blotch " whereas the next highest figure under identical conditions was *Scarlet Knight* with 2.64 per cent. *Ailsa Craig* only gave 0.55 per cent, and *E.S.*1. 0.45 per cent.

In 1943 a pot experiment was carried out to find out the extent to which soil conditions would modify the incidence of blotchy ripening in association with mosaic infection, because for some time it had been noticed that blotchy ripening was consistently associated with mosaic infection. Plants of *Potentate* were grown in ten-inch pots to the five truss stage in nine soil treatments. One half of the plants were inoculated with tomato mosaic virus when the first truss was in bud. The yield of unblemished fruits from both mosaic-infested and control plants was highest for plants grown in the mixture of soil and stable manure. Other treatments gave higher total fruit yields but the proportion of blotchy fruit was increased. When peat was added, there was an increase in the percentage of " blotch", but the increase was greater and highly significant in the case of mosaic-infected plants compared with the controls.

The effect of steaming the soil was to increase the proportion of blotchy fruits in both control and mosaic-infected plants, but to a lesser extent in the latter. The conclusions arising from this experiment were that the type of growth associated with the water-retaining properties of a particular soil mixture is a factor influencing blotchy ripening. For pot work, this factor appears to be most favourable for quality fruit production with a soil-stable manure mixture. Steaming, and the addition of peat, without appropriate manurial adjustments may lead to a watery or " soft " type of growth which is associated with blotchy ripening. A mixture made up with compost and stable manure but without soil, gave the heaviest total yield in both control and virus infected plants, but it led to extreme fluctuations in the water content of the mixture, a condition which was also associated with blotchy ripening.

During the war years, when there was a ready sale for tomatoes regardless of quality, the emphasis was on quantity production and it was not until recently that the demand by the market for better quality fruit has revived interest in the problem of " blotchy " ripening.

It is more prevalent now than it was ten years ago—and this may be accounted for, firstly, by the rapid increase in popularity of the variety *Potentate* which is susceptible to " blotch", secondly, by the scarcity of potash fertilizers over the last ten years and thirdly, by the great increase in the practice of steam sterilization of glasshouse soils during that period.

In 1947 an experiment to test the effect of soil sterilization on blotchy ripening was planned. The variety was *Potentate* in plots unsterilized, with and without base fertilizer, and steam sterilized and formaldehyde treated, both without base fertilizers. The percentage incidence of blotchy ripening was greater in the steamed soil than on that treated with formaldehyde, and the omission of base fertilizers also increased the percentage of blotchy ripening.

The more recent experiments indicate very clearly the considerable susceptibility of the variety *Potentate* to blotchy ripening. They also point out a relationship with manurial treatment and water. The way in which virus infection can influence the disorder is not fully understood, but it may be linked with changes in the rate of transpiration. The

physiological and other factors are still under investigation at Cheshunt. Meanwhile, the answer to this important problem of uneven ripening is still awaited.

Histological Study of Tissues from Glasshouse Tomatoes Affected by Blotchy Ripening. (*J. Agric. Res.*, 1936, **52**, 217-24).

From illustrations and the description, this trouble in the U.S.A. on greenhouse tomatoes is similar to " blotchy ripening " in the British Isles. In the U.S.A. the percentage of affected fruit varies from 1 to 50. At the Michigan Agricultural Experiment Station it was shown that the cavities found in blotchy portions are the result of a collapse of the parenchyma which originally occupied these areas. The breakdown of the parenchymatous cells near and adjacent to the vacular bundles in the blotchy areas, severs the connections of the outlying cells for a transfer of elaborated materials and water, and normal ripening is inhibited. The histological observations reported substantiate an earlier hypothesis advanced by the senior author that blotchy ripening is primarily due to conditions which result from the withdrawal of water from the fruits during periods of excessive transpiration occuring two to five days before the fruit ripens. E.S.

MYCOLOGY

Apple Canker

S. H. Crowdy ([1]) has investigated the possibility of treating apple cankers caused by *Nectria galligena* with growth promoting substances. Preliminary tests were made with a number of these substances, mainly -phenoxy and -naphthoxy acids, in order to determine their effect on the growth-rate of the fungus. The object of this was to eliminate substances likely to stimulate the fungus and select those which tended to depress its growth rate. In the limited number of the tests -naphthoxy acids tended to be more toxic to cultures of the fungus than the corresponding -phenoxy acids. In the -phenoxy series, increase in the number of chlorine atoms in the ring structure was associated with an increase in toxicity. The composition of the side chain also appeared to influence toxicity, the presence of -proprionic acid being associated with a striking increase in toxicity.

Preliminary field trials were carried out in which growth substances at a concentration of 1 per cent in lanoline were applied to cankers on Worcester Pearmain in April. Two fungicides, 8-hydroxyquinoline sulphate and 2-3- dichloro, 1-4- naphthoquinone were also included in the tests. In one series the cankers were cleaned before applying the treatments and in another they were not. When the cankers were re-examined in October, in both series those treated with y-indolyl 3-butyric acid, bis(-2 naphthoxy) acetic acid and 4-chloro, 3-5 dimethyl-phenoxyacetic acid all showed marked improvement over the controls. The second of these three treatments also caused a marked improvement in the quality of the wound xylem produced. These three compounds did not cause marked suppression in the growth of the fungus in the previous experiment, so that the healing of the cankers was most likely

due to their stimulating callus production by the host. However, treatment with the compound containing 8-hydroxyquinoline sulphate produced a similar effect, though that substance did not appear to stimulate callus formation.

In later experiments ([2]) Crowdy tested the effects of a similar range of compounds on wounds made with a 1-in. bit in apple trees. All chemicals were applied in a lanoline paste and in addition to untreated controls there were controls treated with lanoline alone. Wounds made in May were re-examined in September and it was found that lanoline alone gave a marked improvement over the untreated control. The substances most toxic to the Nectria fungus in the previous experiments (8-hydroxyquinoline sulphate and 2-4-6 trichlorophenoxyacetic acid) caused injury to the tissues adjacent to the wounds. Bis(2-naphthoxy) acetic acid had a surprisingly poor effect. The only substance used which produced a marked stimulation to healing was indolyl-3-butyric acid. Though 4-chloro-3-5-dimethylphenoxyacetic acid produced a distinct stimulation at first, the effect was not maintained later in the season. These results tend to confirm that the compounds which checked development of Nectria cankers were those which stimulated healing of the host tissues. The exception to this was the behaviour of bis-(2-naphthoxy) acetic acid but this may have been due to an overdose. The results indicate that growth-promoting substance might with advantage be incorporated in wound dressing.

Brown Rot of Fruits

R. J. W. Byrde ([3]) reviews the results obtained in attempts made to control brown rot diseases of fruit by spraying, particularly in the winter, and gives an account of his experiments made in 1947-48. In some of the winter trials mummified fruits in apple trees (variety Bramley's Seedling), were sprayed with preparations containing copper naphthenate, phenyl mercury chloride, and monocalcium arsenite. In some of the later tests a phenyl mercury chloride preparation containing a wetting agent was also used. Only when applied after the beginning of March did the sprays cause damage. Experiments were also made in which detached mummified apples were treated with the same fungicides. When the fruits were examined in May both the calcium arsenite and phenyl mercury chloride sprays caused a very considerable reduction in the numbers of sporing pustules of the brown rot fungus. The best results were obtained on fruit treated with the phenyl mercury chloride preparation to which a wetter had been added. The copper naphthenate preparation gave unsatisfactory results. In the experiment in which the apples were sprayed on the trees there was less pustule production on trees which had received a routine DNC. wash.

In a subsidiary trial with detached apples monocalcium arsenite, sodium arsenite and a copper-lime-arsenic mixture were used and all proved effective. A small trial was carried out with detached mummified plums. Satisfactory results were given by phenyl mercury chloride, monocalcium arsenite and the copper-lime-arsenic mixture but not with the copper naphthenate preparation or with a miscible tar oil emulsion.

In a small scale summer trial, plum trees were sprayed on June 23 with 1 per cent lime sulphur and a phenyl mercury preparation. When samples were picked from the trees in August, 5.6 per cent of the fruit from the trees sprayed with the phenyl mercury chloride preparation was infected with brown rot compared with 9.7 per cent from the lime sulphur sprayed trees and 22.0 per cent on unsprayed trees. Neither of the sprays caused damage but the lime sulphur spray left an obvious deposit on the fruit. The author emphasizes that although the results of the winter spraying trials are promising, they apply only to inhibition of spore production on mummified fruits and not to the control of fruit infection in the following season. H.E.C.

References

1. A Progress Report on the Effect of certain Organic Acids on the growth of *Nectria galligena*. Crowdy, S. H. *Ann. Rep. Long. Ash. Res. Sta.* 1947, 158-63.

2. A Progress Report on the Effect of Organic Chemicals on the Healing of Wounds on Apple Trees. Crowdy, S. H. *Ann. Rep. Long. Ash. Res. Sta.* 1948, 155-60.

3. Experiments on the Control of Brown Rot of Fruits ; Progress Report 1947-48. Byrde, R. J. W. *Ann. Rep. Long. Ash. Res. Sta.* 1948, 161-73.

ENTOMOLOGY

Studies on Wheat Bulb Fly, *Leptohylemyia coarctata*. A Survey of Infestations in Yorkshire. Gough, H. C. *Bull. Ento. Res.*, 1949, **40**, Pt. 2.

The author states that attacked plants cannot be identified with certainty before the beginning of March and are difficult to detect by the beginning of April owing to the thickness of the wheat crops. The survey was therefore confined to the month of March. A total of 136 fields on 86 farms, spaced as evenly as possible over the arable areas, was examined ; where possible two fields were examined on each farm.

Frames, two feet square, were used in the examination and the field technique is described in detail. It was possible to obtain an approximate figure for the number of bulb fly larvae per acre. Three main categories were selected and will be of interest.

Under 10,000 larvae per acre—Low ; damage would not be noticed in a field at this level.

11,000-100,000 larvae per acre—Moderate ; damage is unlikely to be noticed except in a poor crop.

Over 100,000 larvae per acre—High ; at its lowest levels economic damage unlikely, but indicates that damage is likely in the district.

It is suggested that 300,000 larvae per acre is the critical level, below which serious losses are unlikely.

The survey showed that wheat bulb fly was present in over half of the farms and fields. It was estimated that between two and three thousand acres of wheat and rye in Yorkshire are likely to have a reduced crop as a result of wheat bulb fly attack in an unfavourable season. Over half the dangerous area was found to be in the region around Selby. The only large area where the pest was virtually absent was the Yorkshire Wolds.

High larval counts and wheat failures occur mainly in light land after potatoes and on heavy land after fallows.

Periodic Fluctuations in the Prevalence of Wheat Blossom Midges. Barnes, H. F. *Journ. Animal Ecol.*, 1947, **16,** 74-5.

Two species of midge, *Contarinia tritici* and *Sitodiplosis mosellana*, are well known as pests of wheat, the larvae attacking the ears. This paper describes the results of observations made of this pest during a period of 20 years in a field of permanent wheat at Harpenden. Attention has been directed to the question of delayed emergence and it is now shown that larvae of the two species may still give rise to adult midge after having spent a number of winters in the soil. Larvae of *Contarinia* were found to spend up to three winters and those of *Sitodiplosis* as many as seven winters. Major peaks of larval infestation were found to occur in the years 1931 and 1946 and minor peaks in 1935 and 1941. The two species behaved similarly in respect of peaks and the intervening troughs. The results support a theory of the occurrence of peak infestations of these pests every 4-6 years.

Recent Research on Wireworms. Thomas, I. *Agriculture*, 1949, **56,** 221-8.

This paper sums up the work carried out on wireworms by research workers at universities, Government research stations, those of commercial firms and by the Advisory Entomologists ; the scope of the paper is the period since 1943 when the last full report was issued.

A survey showed that spring oats is one of the most susceptible of the farm crops and work was accordingly concentrated on this crop. The value of extra seed was demonstrated, 50 per cent additional seed giving an increased yield of from 3-5 cwt. per acre. Similar, though less marked, effects were produced by cross-drilling without an increase in seed rate. It had also been shown that increases in seed rates gave similar benefits in connection with sugar beet.

The latest methods for the estimation of wireworm populations are described, these culminating in the Salt and Hollick apparatus, which could be used to extract over 99 per cent of all wireworms or other soil insects.

Laboratory studies are also reviewed, particularly " behaviour " studies conducted at various centres. Included in these studies were such matters as moisture and temperature relations, and response to chemical stimulation ; wireworms were found to be attracted by sugars and asparagine. A furtherance of this work led to the discovery that certain compounds to which wireworms respond are secreted in small amounts by the roots of growing plants.

Feeding studies were of special interest ; wheat and carrots permitted rapid growth, grasses and clover slower growth ; wireworms lost weight on a diet of flax.

Field studies have led to a more thorough understanding of the population changes which take place as the result of ploughing and fallowing operations. Bare fallowing was found to reduce the numbers

of wireworms and damage to crops. In some cases the populations were reduced to less than 10 per cent of the original level, all sizes of wireworms being affected.

An account is also given of advances in the field of chemical control. The use of benzene hexachloride in dust form, broadcast or combine-drilled, is referred to ; and also the use of this chemical in the form of a seed dressing. From two- to five-fold increases in yield have been recorded from such experiments.

This work is rightly selected as an excellent example of co-operation directed towards the solving of a problem. A useful summary of the various ways of tackling wireworm problems is given and this paper, summing up the results of the team work, merits the careful attention of all those who advise farmers.

L.N.S.

VIROLOGY

A Note on Two Viruses affecting Ornamental Plants

The new virus mentioned in this Review (**1**, 3, 134) as affecting broad beans now appears to be associated primarily with *Tropaeolum*, on which it produces a stunting and mottling disease. It has been found affecting *Tropaeolum* in several districts in Cambridge. The virus is aphis-transmitted and has a fairly wide host range, including cucumber and *Petunia*. On the latter it produces a remarkable disease of the ringspot type, especially on the flowers, which may be covered with concentric rings. The virus appears to have no relationship with Cucumber Mosaic virus.

The other virus seems fairly widespread on chrysanthemums, causing a slight mottling of the leaves and a pronounced flower deformation which consists of a partial suppression of the petals. This disease is serious from the grower's point of view because the flowers are useless for market. The virus appears to be an unusual strain of the Cucumber Mosaic virus though it does not infect the cucumber plant.

Resolution of Strawberry Virus Complexes : II. Virus 2 (Mild Yellow Edge). Prentice, I. W. *Ann. appl. Biol.*, 1948, **35**, 279-89.

Aphids (*Pentatrichopus fragariae* Theo.) allowed to feed for several days on a strawberry plant infected with Yellow Edge transmitted two virus fractions. The isolation and properties of one (Virus 1) have been described previously (Prentice and Harris. *Ann. appl. Biol.*, 1946, **33**, 50). The other (Virus 2) was separated by transferring the aphids to fresh indicators after twenty-four hours. Virus 2 was re-transmitted after infection feeding periods of twenty-four hours or more and persisted in the vector for several days. There is some evidence that it is itself a complex of viruses which can be separated further.

On *Fragaria vesca* Virus 2 produced chlorotic spotting, slight marginal chlorosis of the leaves and slight cupping of the leaflets. On *Royal Sovereign* strawberry it produced slight chlorosis of the young leaves. On

Royal Sovereign Viruses 1 and 2 together produced symptoms of Yellow Edge which is thus shown to be caused by a virus complex which can be resolved by means of the aphis vector.

Resolution of Strawberry Virus Complexes : III. The Isolation and Some Properties of Virus 3. Prentice, I. W. *Ann. appl. Biol.*, 1949, **36,** 18-25.

Virus 3 was transmitted by aphids which had been allowed to feed on an infected plant for six days or more and persisted in the vector for several days. There was some evidence that the virus has a latent period in the vector.

On *Royal Sovereign* plants, Virus 3 produced prominent chlorotic spots on the leaves and, sometimes, necrosis along short lengths of the smaller veins. Later some of the chlorotic spots became necrotic and dark red-brown, and there is some distortion and " crinkling " of the leaves. On *Royal Sovereign* Viruses 1 and 3 together produced symptoms of severe crinkle and Viruses 2 and 3 together produced Yellow Edge. A form of Severe Crinkle is thus shown to be caused by a virus complex which can be resolved by means of the vector, and Severe Crinkle is shown to be etiologically distinct from Mild Crinkle.

A Necrotic Disease of Forced Tulips caused by Tobacco Necrosis Viruses. Kassanis, B. *Ann. appl. Biol.*, 1949, **36,** 14-7.

Tobacco necrosis viruses were found to be the cause of a severe necrotic disease which occurred in forced tulips in three different nurseries. From 20 to 50 per cent of some varieties, e.g., *Alberio*, *Korneforus*, *Crater*, *Rose Copland* and *Krelage's Triumph* were affected, whereas others growing under the same conditions remained apparently healthy. The characteristic symptoms of the disease are necrotic spots and streaks, which cause much stunting and twisting and soon kill small plants. The disease was reproduced by inoculating healthy tulips with Tobacco Necrosis viruses.

Studies on the Virus Complex of Carnation. Runley, G. E. and Thomas, W. D. Abstract in *J. Colo. Wyo. Acad. Sci.*, 1948, **3,** 40-1.

Attention is drawn to the increasing prevalence of Carnation Mosaic, Streak and Yellows Viruses in Colorado. The losses due to the Streak and Yellows complex in 1947 amounted to more than 10 per cent of the total production. Among the plants to which the Carnation Mosaic virus will pass are *Zinnia*, celery, sugar beet, *Calendula*, Pinto bean (*Phaseolus vulgaris*), hollyhock, white clover, sweet clover (*Melilotus*) and *Gladiolus*, while aster and *Nicotiana rustica* are liable to infection by Streak. The former virus is readily disseminated by rubbing or with the cutting knife, while both Mosaic and Streak are transmissible by grafting. Cuttings should be treated with calcium chloride, zinc sulphate, or sulphahalidine.

[This disease is evidently very different from the Carnation Mosaic present in England, the virus of which is not transmissible to any of the plants listed above.]

A.R.C. Scottish Raspberry Investigation. Harris, R. V. and Cadman, C. H. *Rep. E. Malling Res. Sta. for* 1947, 50-2.

In further work on raspberry decline at least ten distinct viruses or virus groups, recognized by their symptoms on indicator hosts, have been identified on raspberries in Scotland. Evidence was also obtained indicating that a combination of two viruses of the Mosaic 2 group plays a major part in producing " symptomless degeneration ". Wild raspberries, even those remote from commercial plantations, can serve as reservoirs of virus diseases affecting commercial stocks. Leaf Curl may be caused by a complex of two viruses.

The entire stock of *Lloyd George*, derived from parental material from New Zealand, at present being propagated in Scotland and Suffolk appears to be virus-free. Of 100 new seedlings under trial in Scotland, only three show serious virus infection. Until final selections can be made, duplicates of the plants under trial are being kept in reserve for propagation. Whatever policy is eventually adopted for the commercial propagation of virus-free stocks, it is important to maintain a reservoir of one or two virus-free plants of each variety under adequate protection from infection.

Following recent outbreaks of Loganberry Dwarf on raspberries in the South of England, watch is being kept on English stocks planted in Scotland.

A Late-breaking Virus Disease of Potatoes. Milbrath, J. A. and English, W. H. *Phytopath.*, 1949, **39,** 463.

An unusual virus disease has been found in Oregon which possesses certain characteristics that differentiate it from other viruses associated with potatoes. It has been called " late-breaking virus disease " because the symptoms on plants produced from infected tubers usually develop late in the season. The disease has been tuber-perpetuated for at least two generations and has been transmitted to healthy plants by grafting. The disease is very erratic in behaviour and symptom expression—a fact that will make it difficult to detect and eradicate from seed stocks.

The Influence of Light Intensity on the Susceptibility of plants to Certain Viruses. Bawden, F. C. and Roberts, F. M. *Ann. appl. Biol.*, 1947, **34,** 286-96.

Reducing the light intensity under which plants were grown in summer to one-third increased their susceptibility to infection with Tobacco Necrosis, Tomato Bushy Stunt, Tobacco Mosaic and Tomato Aucuba Mosaic viruses. With the first two viruses, shading increased the average number of local lesions per leaf by more than ten times and by more than five times with the second two.

Reducing the light intensity increased the virus content of sap from leaves inoculated with Rothamsted Tobacco Necrosis virus by as much as twenty times. As it also reduced the total solid content of sap by about one-half, purification was greatly facilitated ; crystalline preparations of the virus were readily made from shaded plants but not from unshaded controls. Also reducing the light intensity increased the virus

content of systemically infected leaves ; the greatest effect was with Bushy Stunt virus with which increases of up to ten times were obtained, but with Tobacco Mosaic and Aucuba Mosaic viruses there were also significant increases. The importance of controlled illumination in raising plants for virus work and the possible mechanisms responsible for the variations in susceptibility are discussed.

Aphid Transmission of Cauliflower Mosaic Virus. Severin, H. H. P. and Tompkins, C. M. *Hilgardia*, 1948, **18**, 389-404.

In studies carried out in California on the aphid transmission of cauliflower mosaic, certain aphids, such as *Brevicoryne brassicae* and *Myzus persicae*, which normally do not feed on cauliflower, were found to be more efficient transmitters than those which do. *B. brassicae* was the more efficient vector of these two.

Of 21 cauliflower varieties tested none was resistant to experimental infection with aphids. Aphids acquired the virus in fifteen to twenty-five minutes on a diseased cauliflower plant (five to ten minutes actual feeding time) and transmitted it in feeding periods of five to ten minutes. In tests with short feeding periods most transmissions occurred during the first ten minutes after transfer.

Ein Schnellverfahren zum Nachweis des Kartoffel-A-Virus (vorläufige Mitteilung) [A Rapid Method for the Demonstration of Potato Virus A (Preliminary Note)]. Köhler, E., *Kartoffelwirtsch.* (Hamburg), 1948, **3**, 56.

The author states that *Solanum demissum* is a useful indicator plant for Potato Virus A. In order to avoid mistaking the blackish-brown lesions for those of Potato Virus X, which produces similar lesions at high temperatures, it is recommended that the leaves should be removed after inoculation and placed in a Petri dish with damp filter paper. The dishes should then be placed in a well-lighted room, out of direct sunlight. The spots should then become visible in 3-5 days.

Het stippelstreep van de Boon *(Phaseolus vulgaris)* een ziekte veroorzaakt door een virus, dat in de grond overblijft [Stipple Streak of the Bean *(Phaseolus vulgaris)*, a Disease caused by a Soil-borne Virus]. Van der Want, J. P. H. *Tijdschr PlZiekt.*, 1948, **3**, 85-90 (English Summary).

Field experiments have shown that this virus, which causes the Stipple Streak disease of beans in Holland, persists in the soil. Steaming for 30 minutes at 100° C. is sufficient to sterilize the soil. Natural infection may develop in young bean plants within a week of sowing in contaminated soil, but the symptoms of Stipple Streak do not appear until some time later, sometimes as long as six weeks.

[This virus has now been shown by serological tests at Cambridge to be one of the Tobacco Necrosis viruses. It is interesting that it appears to be only in Holland that Tobacco Necrosis viruses become systemic in their host plants, at all events so far as the French bean is concerned. The tulip plants infected with Tobacco Necrosis viruses, described in these notes (see p. 131) came from Holland also.]

The Control of Spotted Wilt of Tomatoes. Du Toit, J. J. *Fmg. S. Afr.*, 1948, **23**, 786-8.

This is an account of attempts to control *Thrips tabaci*, the chief vector of the Spotted Wilt virus. Three treatments were used : 4 per cent nicotine dust (weekly), 0.5 per cent BHC (fortnightly), and 5 per cent DDT (three-weekly). All plots were rogued of diseased tomato plants twice a week, and the results were as follows : nicotine dust gave 65.91, BHC gave 67.42 and DDT gave 67.42 per cent healthy plants, as compared with 37.12 for the control plots.

It is recommended that plants in the seedbed should be dusted lightly with 4 per cent nicotine dust every two or three days. Strong and healthy plants should be selected and set out twice as densely as usual ; the nicotine dust should be applied again one week later, followed by two more dustings at weekly intervals. In addition, every third week 5 per cent DDT should be applied lightly up to six weeks after the first picking. It is important to remove all diseased plants. DDT should not be applied to small plants in the seed beds. [These treatments are adapted to outdoor tomato growing in S. Africa but it is probable that nicotine dust and DDT could be used with profit in this country under glasshouse conditions to keep down the vector of tomato spotted wilt.]

K.M.S.

INSECTICIDES AND FUNGICIDES

Poison Hazards of the Newer Insecticides

Recent news of unfortunate accidents in the field use of parathion in America will inevitably raise questions of the hazards due to the mammalian toxicity of the new insecticides. In the United States public confidence in the safety of DDT is slowly recovering from the scare initiated by a report in the American *Journal of Digestive Diseases* for March 1949 that a malady attributed to a hypothetical " virus X " was in reality due to DDT poisoning. A Public Health Service statement in the *Journal of the American Medical Association* for April 30, 1949, reassured the public that reports that DDT was responsible for causing the Virus X diseases of man and cattle were totally without foundation, both of the diseases being known before the insecticidal use of DDT. It would seem that the only remaining doubt concerning DDT hazards arises through the known accumulation of DDT in body fat and its excretion in milk. DDT has been detected in the milk of cows fed with DDT-contaminated fodder or treated with DDT for fly control. Until it is certain that the amounts of DDT likely to be present are non-injurious, it would be criminal to recommend uses of DDT likely to cause milk contamination if this milk is to be fed to infants to whom it would constitute almost the whole diet.

The parathion cases present unusual features. A senior assistant, engaged in an experimental application of a parathion wash with a " Speed Sprayer", complained of headache and dizziness which he knew were the early symptoms of parathion poisoning. He carried on in the hope of completing the spraying but after vomiting, soon became too ill

to continue. Instead of making straight for hospital and oxygen supplies, he went home and before the doctor arrived he was dead. A second fatality was a farmer who had applied parathion at four times the recommended concentration but no further details of this case are available. The third case was more fortunate ; he had been using parathion in a glasshouse fairly regularly over a period of a fortnight. He became seriously ill during the night and was admitted to hospital the following morning, soon becoming comatose. After artificial respiration for two hours he recovered, and within 24 hours his symptoms had disappeared. The remaining cases were among pear pickers sent into a plantation sprayed ten days before with parathion. Many of the ninety pickers engaged were taken ill and sixteen were sent to hospital where they quickly recovered. Happily, spray residue estimations had been made just before picking and the leaves bore residues of 5 p.p.m., an abnormally high figure attributed to the unusually dusty condition of the foliage at the time of spraying.

Clearly the lessons of these tragedies are that parathion is to be treated with the greatest caution, that the early symptoms of headache, dizziness and vomiting are never to be disregarded, and that a hospital equipped with an artificial respiration apparatus is the best place for treatment. But in view of the unusual features of the cases, it is to be hoped that an exaggerated view of the dangers will not prevail. Looking at the problem dispassionately two aspects merit attention ; firstly, the immediate danger to the spray gang ; secondly, the risks of cumulative poisoning to the general public through the sale of insecticide-contaminated produce. The magnitude of the first risk may be best assessed by considerations of the toxicity of the insecticide by skin application, from which Lehman (*Bull. Assoc. Food and Drug Officials*, 1948, **12**) estimated the quantities dangerous to man to be those given in the Table. When it is remembered that the normal spray concentrations of parathion and of lindane are below those of nicotine, it would seem that the new insecticides present hazards to the spray gang of the same

Table

Acute and chronic mammalian toxicities of insecticides (after Lehman)

Insecticides	Quantities dangerous to man when applied to skin		Chronic toxicity to rats	
	Single exposure g.	Daily exposure g. per day	Lowest dose p.p.m.	Duration weeks
DDT ..	169	9	100	104
Parathion	3	0.3	25	4
HETP ..	—	0.3	—	—
Nicotine	3	2.4	60	43
Rotenone	Large	—	31	16
Lindane	3	1.2	400	52

order as those of nicotine, though the latter are more serious than seem to be generally recognized.

The risk of cumulative poisoning is much more difficult to assess and Lehman points out that his data are preliminary. Long test periods are clearly involved and the interpretation of results on rats to likely results on man is speculative. Parathion is the most toxic of the insecticides listed, but it is necessary to compare its figures with those of rotenone long regarded as a safe insecticide. If it is remembered that the rat figures are based on p.p.m. of the whole diet, the risks of poisoning for spray residues on food crops become correspondingly less if the sprayed crop, as is usual in the case of man, forms but a part of the diet.

H.M.

SOILS

Organic Matter and Nitrogen Contents of Soils as Influenced by Management. Lee, C. K. and Bray, R. H. *Soil Sci.*, 1949, **68,** 203-12.

The loss of organic matter in soils is a major problem of agriculture. Humus is still regarded as a source of nitrogen for crops rather than as a soil conditioner. Most farming systems aim at maintaining the humus content as high as possible but usually fail by a considerable margin. Calculations of the balance of nitrogen show that there is usually a deficiency of nitrogen which must be supplied by the humus. Approximately 100 lb. of humus is destroyed to provide 5-6 lb. of nitrogen. This loss of humus explains the erosion of soils, as humus produces good textured soils difficult to erode.

Experiments have shown that ploughing in all plant residues, liming to correct acidity, and adding phosphate and potash increased the nitrogen content on dark soils by 220 lb. in the last 10 years. Similar treatments on light coloured soils gave an increase of 130 lb. but addition of potash was essential on these light potash-deficient soils. On dark soils not potash-deficient, addition of potash gave an increase of 285 lb. nitrogen in 10 years, double the amount stored without potash. This conservation was probably due to increased biological activity, fixation by organisms and increased growth of leguminous catch crops. In 10 years 39,000 lb. of dry matter were calculated to be returned on the completely fertilized plot on light soil and 52,000 lb. on the dark soil.

The main problem was the conversion of plant residues to organic matter. Straw ploughed in alone reduced yields, while burning loses nitrogen. Mulching appeared satisfactory if mineral nitrogen was added. If crops removed more nitrogen than was supplied, the nitrogen was used from the organic matter and the content of organic matter was not maintained. The higher organic matter and nitrogen contents of the treated plots compared with the controls, showed that renewal of organic matter was taking place. The common view that the organic matter content of soils cannot be increased was due to insufficient nitrogen applications to balance losses in drainage and crops. It was calculated that at least 20.5 lb. of nitrogen per year would be necessary to maintain the organic matter at its present level. Additions of mineral

nitrogen would provide for increased crop yields as well as maintenance of the organic matter content, provided the losses of other nutrients were made up. Much of the present trouble was due to the short term effect of organic matter due to the lack of nitrogen.

T.G.H.
W.M.D.

MACHINERY

Horticultural Machinery

Kearns, H. G. H. and Dorey, O. G., in an article entitled "Some Reflections on Machinery for Fruit Production" (*Sci. Hort.*, 1949, **9**, 127-31) find that the acreage of fruit (240,000) in this country does not offer a big market for specialized equipment, but consider that mechanization could help more in solving problems of weed control, irrigation, frost protection and the collection and disposal of prunings. The view is expressed that, as spraying may sometimes account for up to 50 per cent of the yearly cost of producing a crop, the layout of orchards should be planned to suit automatic spraying machines. The crop will have to be grown as hedges, a system which will fit in well with the modern tendency to grass down the orchards and keep the grass short by means of gang mowers.

Figures are given for tractor work on a 50-acre orchard in the seventh year from planting, the main items being cultivations (368 hours), spraying (234 hours) and fruit haulage (12,000 bushels ; 373 hours) out of a total of 1,138 hours. Attention is drawn to the need for mechanizing the collection and burning of prunings.

P. H. Brown, writing in the same publication (Some Reflections on Machinery for Vegetable Production, pp. 132-6) considers that vegetable growers, both large and small, require, as their power unit, different sizes of a universal machine which provides a wide speed range, accurate steering, provision for working down rows 12 inches apart, and the fitment of multi-row tools for drilling, hoeing, transplanting, ridging, fertilizer placement, spraying, dusting and gassing. With deep ploughing and haulage these varied requirements present the engineer with a difficult task, but the writer argues that the universal machine is more economical than a number of specialized machines suited to the different jobs.

A further article (Irrigation of Horticultural Crops, Rhodes, J. and Skillman, E., op. cit. pp. 137-42) surveys the water requirements of crops giving examples of the present state of knowledge by reference to the needs of radishes and brassica crops. The writers discuss the application of major and minor nutrients in the irrigation water and consider the problems met with in advising growers on choice of irrigation equipment for open land, glasshouse and fruit crops. The present cost of open-land irrigation is put at well over £100 per acre, even where the water is taken from a stream and no well boring is required. Rotary rainers are generally cheaper than oscillating spray lines.

Skillman, E. (Irrigation of Crops, *Farming*, September, 1949, 278) discusses the effects of the 1949 drought with reference to high-value

crops, and considers the part that irrigation might play in the agricultural programme. The equivalent of an inch of rain (23,000 gallons per acre) will moisten a heavy soil that is really dry to a depth of only 4½ to 5 inches, and since half of that water can be lost as a result of evaporation alone in three to five days, it is evident that substantial quantities of water are sometimes needed. Company's main water at a cost of up to 2s. per 1,000 gallons is best ruled out, except by the small market gardener and glasshouse grower. There are, however, many situations where soils and crops are suitable, and good supplies of water are available. Irrigation equipment and nutrient solutions are discussed.

Courshee, R. J. and Hoare, E. R. (*N.I.A.E. Report on the Protection of Orchards from Frost*) briefly survey the earlier work done in Britain and in other countries on frost protection, and describe preliminary experiments carried out by the N.I.A.E. in 1948-49. Among the equipments tried was one involving the use of 20 ft. and 30 ft. diameter horizontal fans designed to blow down the warmer air from above the orchard during typical spring frosts when there may be a considerable temperature gradient between tree level and only a few feet above. In the preliminary trials, a tractor-driven 30 ft. fan was found capable of exerting an appreciable influence on temperature over an area of about an acre. Under suitable conditions (i.e. with " radiation " frosts and a strong temperature " inversion ") temperature rises of up to 8°F. below the fan and 2-3°F. 80 yards away were recorded. Running costs were low. By comparison, a test of 60 oil heaters per acre burning 30 gallons of oil per acre per hour gave a mean temperature rise of 4°F. In this case heating was almost entirely by radiation. The need for further work is emphasized.

Yeo, M. L. (Fuel Utilization in Horticulture, *Sci. Hort.*, 1949, **9**, 161-70) discusses glasshouse heating systems, soil sterilization, soil warming and orchard heating. The main types of boilers and furnaces are described and reference is made to steam and electric space heating. It is stated that some 72 per cent of the heat loss from a glasshouse takes place through the roof, and this shows the possibility of achieving worth-while economies by insulation on a frosty night. The article consists of a comprehensive but generalized review of heating systems, and includes an extensive bibliography of 52 references.

Skillman, E. (Soil Sterilization—1, *Brit. Farm Mech.*, October, 1949, 252-3) describes modern methods in commercial glasshouse practice in Britain. Steaming is the most effective and most widely used method, and portable loco-type boilers with an evaporative capacity of 1,000 to 2,500 lb. steam per hour are commonly employed. Of the three main methods of distributing the steam into the soil, the Hoddesdon pipe method is generally preferred to the forked grid or to the harrow grid system. The pipes are laid 12-18 inches deep at 18-20 inches apart, and steam passed until the temperature of the soil reaches 210-212°F. The steam is then passed for a further 10 minutes. The heating-up period is generally 15-20 minutes, depending on soil and depth of pipe. Detailed advice is given on satisfactory methods of checking the temperature. C.C.

E41012 Wt. 51-31 K30 3/50 Gp. 8 Fosh & Cross Ltd., London

N.A.A.S. QUARTERLY REVIEW

Single copies - - - price 1s. (1s. 2d. by post)
Annual Subscription - - 4s. 6d. including postage

SALES INQUIRIES should be addressed to the publishers at any of the addresses given on the back cover.

EDITORIAL COMMUNICATIONS should be addressed to the Editor, N.A.A.S. Quarterly Review, Ministry of Agriculture and Fisheries, St. Andrew's Place, Regent's Park, London, N.W.1

Crown Copyright Reserved

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

To be purchased directly from H.M. Stationery Office at the following addresses:
York House, Kingsway, London, W.C.2; 13a Castle Street, Edinburgh, 2;
39 King Street, Manchester, 2; 2 Edmund Street, Birmingham, 3;
1 St. Andrew's Crescent, Cardiff; Tower Lane, Bristol, 1;
80 Chichester Street, Belfast
OR THROUGH ANY BOOKSELLER

1950

Price 1*s.* 0*d.* net

S O. Code No. 72-20-4-50